PUBLIC WORKS

May 1961

CITY, COUNTY AND STATE

Studies on Processes for ABS REMOVAL from Sewage page 101

Channelizing Street INTERSECTIONS to Speed Traffic page 105

Preparing a 5-Year Program for Decatur's CAPITAL IMPROVEMENTS page 111

Pavement Design for FLEXIBLE SURFACES page 114

$KMnO_4$ Controls TASTES and ODORS Due to Vegetation page 129

Complete List of Articles and Features on page 5

Charles T. Haskell, [illegible] of the ASCE, is shown here against a background [illegible] at the Queens Lane plant, Philadelphia, [illegible] this firm participated. More on page 16.

Complete on-the-go control speeds up work with the big-capacity, 85-inch International hydraulic Bullgrader. Lift, lower, tilt, or angle in an instant . . . effortlessly, with fingertip ease.

Here's the only bottom-dump action available in any ¾-yd loader—the amazing International Drott T-340 Four-in-One—a clamshell, scraper, dozer, and standard bucket, *all in one!*

Adaptable! This T-340 with Bullgrader was crane-lowered to the bottom of an 8,000,000-gallon water reservoir, to clean a 20-year accumulation of silt from the drained reservoir.

Lick small job costs!

with T-340 stamina and 47 hp economy*

Here's go-anywhere traction at a budget price! . . . in a compact size that's easily transported between the host of small jobs that continually confront every contractor and public works official. A five-ton tilt-bed trailer pulled by a pick-up is all you need to take an International® T-340 or TD-340 from job to job quickly, at low cost.

At the job, you'll be surprised—and pleased—to see how much work a T-340 will turn out with 85-inch Bullgrader®, ¾-yd International Drott 4-in-1, 10-foot backhoe or other low-cost equipment ideally suited to the widest range of jobs. Exceptional power-to-weight ratio gives these sturdy crawlers the push and pull-power that would do credit to larger, more costly units. For loading and dozing you can get *five* reverse speeds with Fast-Reverser, each 22½ per cent *faster* than the corresponding forward speed. Planetary-type steering gives easy control with the steering levers, alone.

Users call them "terrific!"—and the International Dealer near you will gladly show you *why* with an on-the-job T-340 or TD-340 demonstration. For new, illustrated catalog, write International Harvester Company, Dept. PW-5, P.O. Box 7333, Chicago 80, Ill. **Maximum engine hp at standard conditions*

5,000 dealers backed by 12 parts depots

INTERNATIONAL HARVESTER

Grand Avenue Station, Downers Grove, Ill.,
Consoer Townsend & Associates, Engineers

OVER 13,000 FLUSH KLEEN INSTALLATIONS

FLUSH KLEEN OFFERS THESE ADVANTAGES

• Low Original Costs • Smaller Motors
• Pumps Handle Clear Liquid Only • Smaller Pumps

NUISANCE-FREE AND TROUBLE-FREE SEWAGE PUMPING

FLUSH KLEEN Clog-Proof Sewage Pumps are trouble-free, nuisance-free units which meet today's requirements. They are designed to handle high solids loadings of wet strength paper products and ground garbage without clogging or interruption . . . and operate with smaller pumps and motors. *Solids never reach the impeller!*

TWO MAJOR DESIGN IMPROVEMENTS NOW AVAILABLE

❶ **New FLO-THRU STRAINER**
Permits greater solids loadings

❷ **New BY-PASS FITTINGS**
Allows greater inflow capacity
Permits pump selection based only on discharge capacity

SOLIDS NEVER REACH THE IMPELLER!

Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION
HYDRODYNAMICS DIVISION

CHICAGO PUMP

622F DIVERSEY PARKWAY • CHICAGO 14, ILLINOIS

©1961 CP-FMC

Special Report to Users of Caterpillar Equipment: Custom TRACK SERVICE

Custom Track Service saves coal stripper $3298 by adding 3800 hours to track life

A coal stripper, ripping and 'dozing rocky overburden 7 days a week around the clock, was averaging 2300 hours of life before he *replaced* most of his totally destroyed track group parts. At the suggestion of his Cat Dealer, the stripper tried new, larger-size undercarriage parts. By following recommendations of the dealer's undercarriage specialist at 2440 and 4030 hours, the undercarriage went a total of 6100 hours with only pin and bushing replacements . . . and all but the shoes were rebuildable instead of scrap! Up to this point, Custom Track Service saved the stripper a $3298 cash outlay; and since he was able to rebuild the links and reuse the pins and bushings instead of replacing with new assemblies, he realized additional savings.

PAST EXPERIENCE

ALL BUT SHOES READY FOR SCRAP PILE AFTER 2300 HOURS

PRESENT EXPERIENCE

COMPLETELY REBUILDABLE EXCEPT SHOES AFTER 6100 HOURS

HOW CUSTOM TRACK SERVICE HELPS LOWER COSTS

Custom Track Service, available only from your Caterpillar Dealer, is designed to help you get the most possible service from undercarriage parts and thus cut costs. Factory-trained specialists are ready to help solve your particular track problems. They can give sound recommendations to help you get the most from your undercarriage.

They can advise you on maintenance . . . help you tailor the many special undercarriage parts and track options available to meet various job conditions. As a result, costs per hour go down and profit and machine availability go up.

These undercarriage specialists are backed by modern track undercarriage rebuilding facilities manned by experienced personnel . . . by the largest and most complete stock of standard and special application parts available . . . by Parts Exchange Assemblies that keep tractors working and earning.

Check with your Cat Dealer and learn how Custom Track Service can help you to reduce costs.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

PUBLIC WORKS

THE MOST USEFUL ENGINEERING MAGAZINE FOR CITIES, COUNTIES AND STATES

MAY, 1961 • Volume 92, Number 5

The Removal of ABS from Sewage 101
Summary of investigations at the University of California, where present processes were reviewed and new ideas studied.
P. H. McGauhey and S. A. Klein

Principles and Fundamentals of Intersection Channelization 105
The author shows how this engineering tool may be used to provide safe, economical and efficient traffic flow at points of conflict. W. C. Kerr

Revised Collection Routes Meet Suburban Growth 108
Time studies result in more efficient collection routes; show need for larger packer equipment.
William A. Sommers

Steps in Preparing a 5-Year Capital Improvement Program 111
Well-planned program reviews all projects, priorities and financing methods to coordinate improvements in Decatur, Ill. E. B. Bodnar

BASIC PRINCIPLES OF PAVEMENT DESIGN:
Part III—Flexible Pavements 114
A discussion of flexible pavement components, stresses, design and materials, concluding a three-part series. E. J. Yoder

Vacuum Loader Speeds Street Cleaning 125
How vacuum machines are used by Milwaukee to load street sweepings and empty ice-control sand boxes. William J. Rheinfrank

Monitoring the Lower Mississippi 126
New warning network alerts municipal water users of accidental river pollution. John E. Trygg

Runoff Storage Reservoir Will Relieve Dry Summers.... 128
Construction of a supplementary reservoir to store surplus runoff.

Water Supply Tastes and Odors Controlled by Potassium Permanganate 129
New reservoir which was filled by heavy rains before being stripped of vegetation posed an unusually severe problem. J. L. Smith

Sealing Sewers by External Grouting of Joints 131
Serious infiltration remedied with grouting operations which were controlled by closed-circuit TV. Fred D. Dahlmeyer

Pumping Water by Air-Lift 133
How principles of air-lift pumping can be used to develop and test new wells.

Ultrasonic Cleaners Cut Our Parking Meter Maintenance Overtime 135
Self-tuning ultrasonic waves that agitate cleaning solution cut time from 30 to 5 minutes per meter.
George H. Smith

Sewer Maintenance Crew Specialized in Safety 136
When "old hands" would not use safety equipment conscientiously, a new crew proved the answer for emergency work. A. J. Mair

Tunnel Gets Automatic Signal System 138
Emergency traffic control and routine maintenance activities facilitated by new installation.

Urban Snow Removal Conference 152

Gas Engines Power Pumping Plant 156

Custom-Engineered Luminaires for Municipal Garage 165

Big Pipe Sections for Outfall Line 166

Do Consulting Engineering Services Cost—Or Pay? 174
The variable functions of engineering are assessed.
John Girand

Typhoid Traced to Bathing at a Polluted Beach 182

Color Photos Check Sewer Coatings 184

Plastic Barrels Save Money on Refuse Collection 186

PUBLIC WORKS DIGESTS:

Highways and Airports 146

Water Works 156

Sewerage and Refuse 166

Industrial Wastes 176

EDITORIAL DEPARTMENT

W. A. Hardenbergh, *Editor*
Edward B. Rodie, *Managing Editor*
Clayton H. Billings, Lloyd G. Byrd,
Helen E. Quinn, *Associate Editors*
Alvin Jacobson, *Digest Editor*
Nathaniel Pousette-Dart, *Art Consultant*

DEPARTMENTS AND SECTIONS

The Editor's Page 7
Leader in Public Works .. 18
Books in Brief 22
Letter to the Editor 23
Reviews of Catalogs 34
Legal Notes 60
Municipal Power 74
Ed Cleary Reports 86
Engineering Notes 90
APWA News Bulletins 141
New Equipment 194
Job Opportunities 200
Films in Brief 200
News of Engineers 201
Worth Seeing 203
Worth Telling 204

READERSHIP Estimates RESEARCH

Established 1896
Public Works T. M. Reg. U.S. Pat. Off.

Published Monthly by Public Works Journal Corporation. Office of Publication at Orange, Conn. Editorial and Advertising offices at 200 So. Broad St., Ridgewood, New Jersey. Subscription rates: U.S.A. and possessions, $5.00. All other countries, $7.00. Accepted as controlled circulation publication at Orange, Conn.

BPA

PUBLIC WORKS JOURNAL CORP.
200 So. Broad St., Ridgewood, N. J.

MONOTUBE POLES
in steel or aluminum

. . . engineering and styling to meet today's rigid outdoor lighting requirements

Business District Lighting

Highway Lighting

Residential Lighting

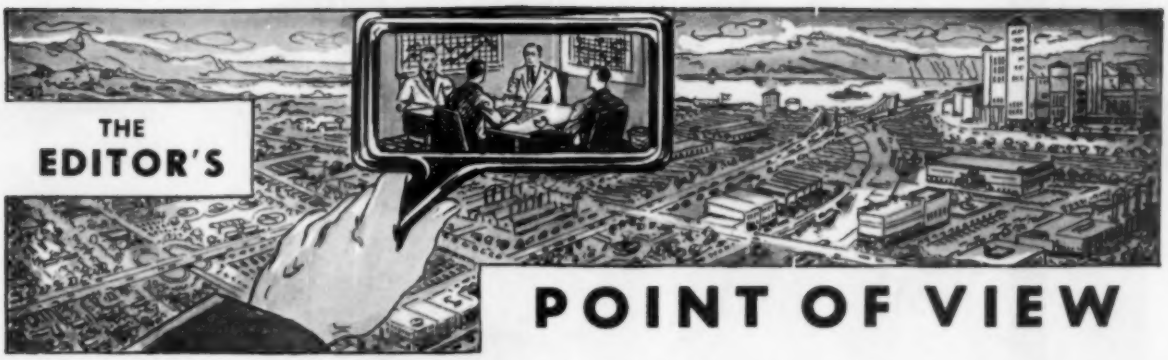
Area Lighting

UNION METAL

THE UNION METAL MANUFACTURING COMPANY

Canton 5, Ohio Brampton, Ontario

Monotube Engineered Lighting Poles



THE EDITOR'S POINT OF VIEW

Shopping Centers Parking, Lighting, Drainage and Waste Disposal

ABOUT 900 SHOPPING centers were built in 1960 and it is estimated that the average floor area was 77,000 sq. ft. per store. Further, it is estimated that about 8,000 such centers will be constructed between now and 1975. Many of these will be located outside of municipal limits where building and other appropriate codes do not exist or are inadequate.

In addition to safety for shoppers using the stores, many other requirements are necessary to make these installations good members of the community. A location that does not create a traffic hazard is one. Others include provision of parking, which is usually adequate because of business needs; lighting of the parking area; storm drainage for the roof and paved areas; and disposal for the wastes, both liquid and solid, generated by the service personnel, the customers and the processes of doing business.

This is a case where prevention of unsatisfactory conditions, though requiring some extra effort initially, will be far easier than curing the defects that are otherwise sure to occur in a good proportion of these establishments.

The Situation for Pollution Control

NOT ONLY IN Congress, but in many state legislatures, consideration is being given to new administrative plans for pollution control. In general, these provide for either a new and independent unit outside the health department or the Public Health Service, or for a new unit within such established agencies.

To us it seems that the implied dissatisfaction with existing agencies which these proposals indicate is due largely to the lack of effective leadership which appears to have existed in this field in the past; or, if there has been leadership, inadequate communications for transmitting it to the working agencies has largely nullified it.

It is late; yet not too late, we hope. The Water Pollution Control Federation has as its president one of our country's most capable sanitary engineers; and it has other strong assets and capabilities. It is time for all who have responsibilities and interests in this field of pollution control to unite in providing grass roots leadership, through the Federation and other available agencies, whereby an effective program can be achieved, irrespective of the shape that coming legislation takes. It could be a most serious matter, in case responsibility passes into new hands, and leadership along with it, that public works engineering should lose the contact and influence so essential to sound progress.

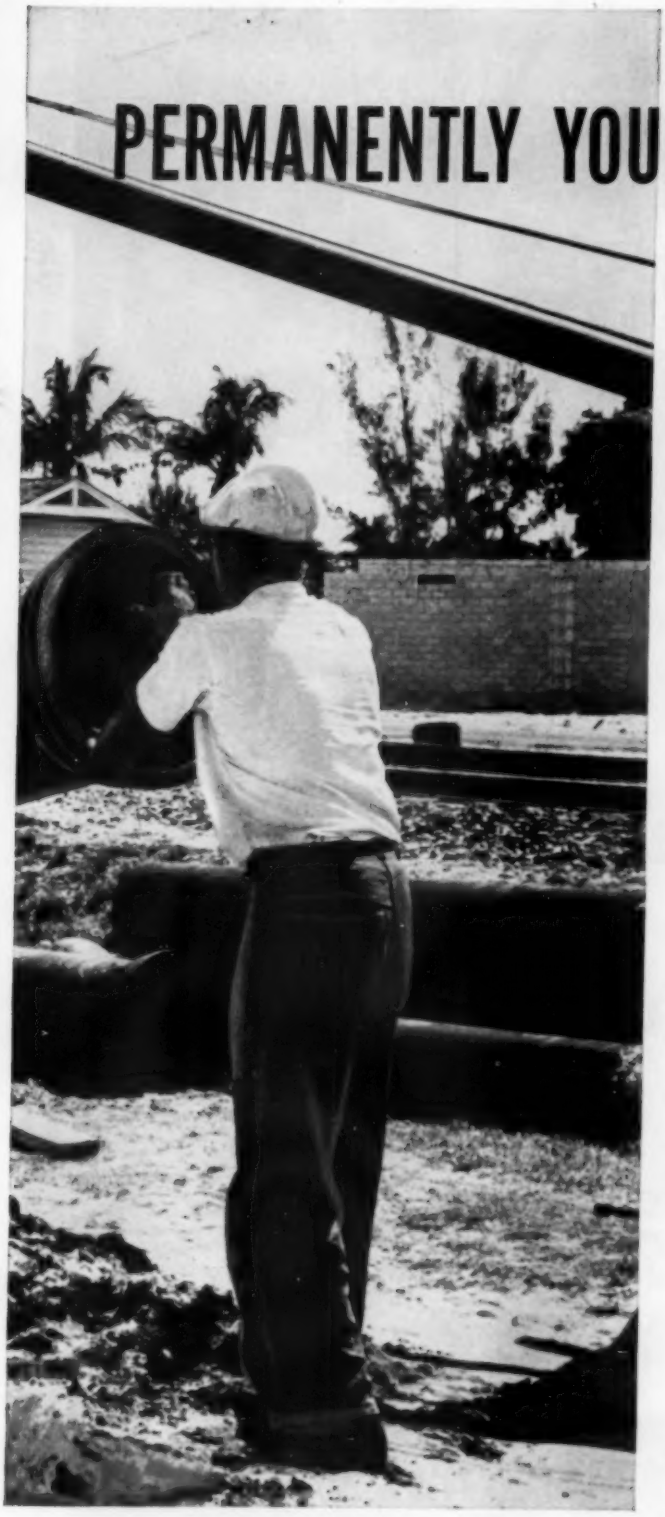
The Acceptance of Instrumentation

THE EXTENSIVE use of instruments for operation of water and sewerage systems and plants has been greeted variously with enthusiasm, indifference or even opposition among design engineers and municipal supervisory personnel. But the trend that caught on from industrial practice is definitely toward acceptance of automated control. There is no question that operating costs can be lowered by automation. Besides the obvious savings in manpower, especially in large and complex systems, other savings in the form of economical control of pumping and treatment chemicals can be realized. Human error can be eliminated. Some opponents of the idea mistrust the ability of the machines to give lasting satisfactory service. The answer to this is that any equipment is as reliable as the firm that manufactures it. Others may oppose instrumentation because it introduces concepts they do not understand. The answer here is: As a professional person, you have an obligation to keep informed.

National Highway Week

NATIONAL HIGHWAY WEEK, May 21-27, offers an opportunity and a challenge to every one of us. With national attention being specially directed during that time toward our highway program we should take every opportunity to present a clear and objective story to the public of the needs and values of this program. The challenge lies in recognizing and reaching "the public"—that vague body made up of your neighbors and ours. Their interest lies primarily in the streets and highways they use to get to work or to travel on vacation and business trips. That is the story they want to hear and that is what we should tell them about. Let each one of us do our best to present the need for and the values of our highways, stressing always the necessity for using the best of engineering skill, materials and equipment.

THE MARK OF THE 100-YEAR PIPE



PERMANENTLY YOURS: CAST IRON PIPE

Installed... it stays installed

One thing sure about cast iron pipe—once it's in the ground, it's there for keeps! Over 100 American utilities, having used cast iron pipe steadily for more than a century, can testify to that. And *modern* cast iron pipe gives you greater assurance than ever: great beam strength resists heavy surface traffic; tremendous load resistance absorbs even the most forceful pressures. In fact, when you select cast iron pipe, you can anticipate no major repairs in your water supply system for the next hundred years!

Cement-lined—it stays cement-lined

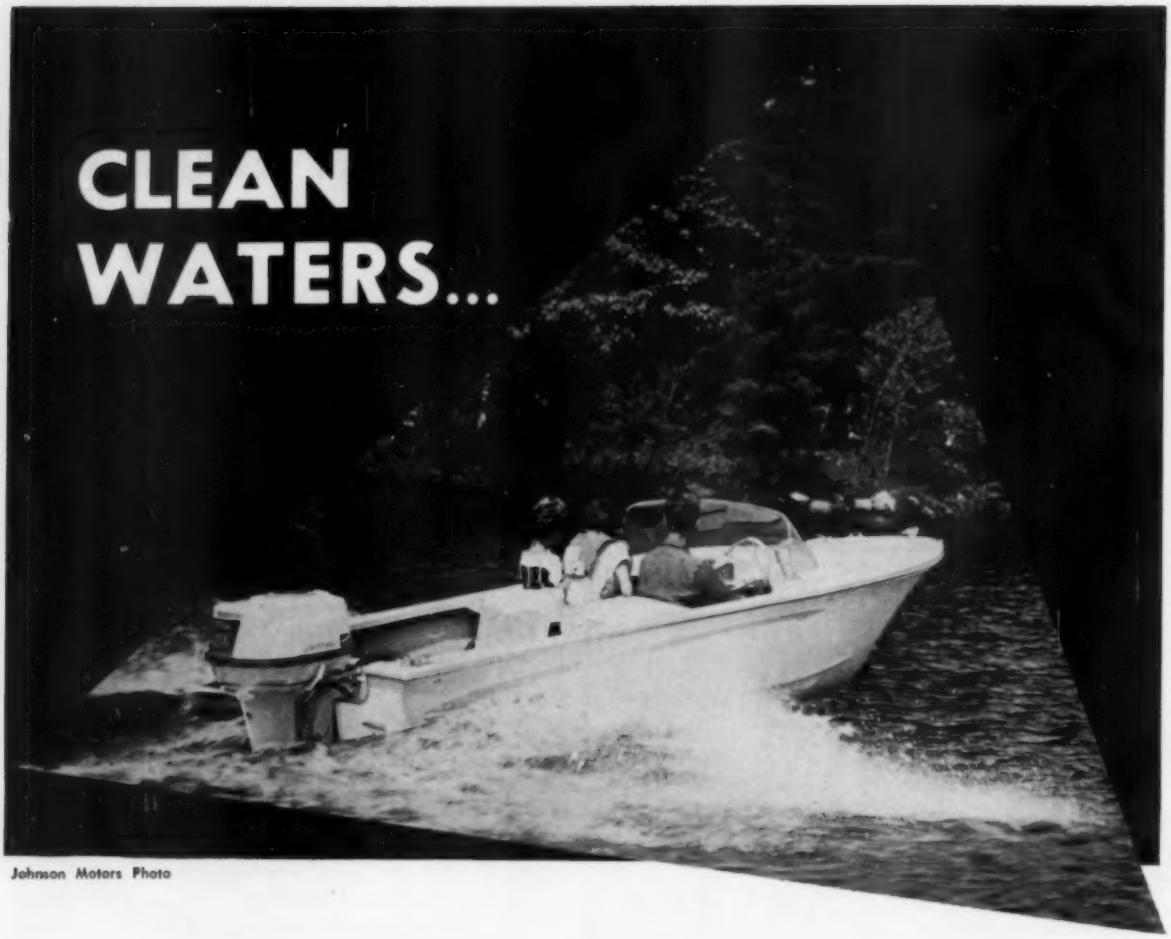
A smooth coat of cement lining along the inner wall helps prevent the formation of flow-reducing particles. No matter how strong the water is, cast iron pipe always assures a free, steady flow.

Joined—it stays joined

Bottle-tight, rubber-ring joints give you leak-proof protection at the most vulnerable points of your system. Vibrations, surface traffic and washouts present no problem to cast iron pipe. Inherent ruggedness . . . built to perform under all adverse underground conditions . . . repair-free service for at least a century—all good reasons why your choice should be that of water utility experts everywhere. America's greatest water carrier: cast iron pipe.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois

CAST IRON PIPE



Johnson Motors Photo

are good business

New industries, bigger payrolls, larger property and taxable values follow the clean-up of pollution in local waters. Boating, fishing and bathing become added sources of important spending that funnels new money into far-sighted communities that realize first that clean waters are no longer merely desirable — they are *necessary* to prestige, prosperity and health.

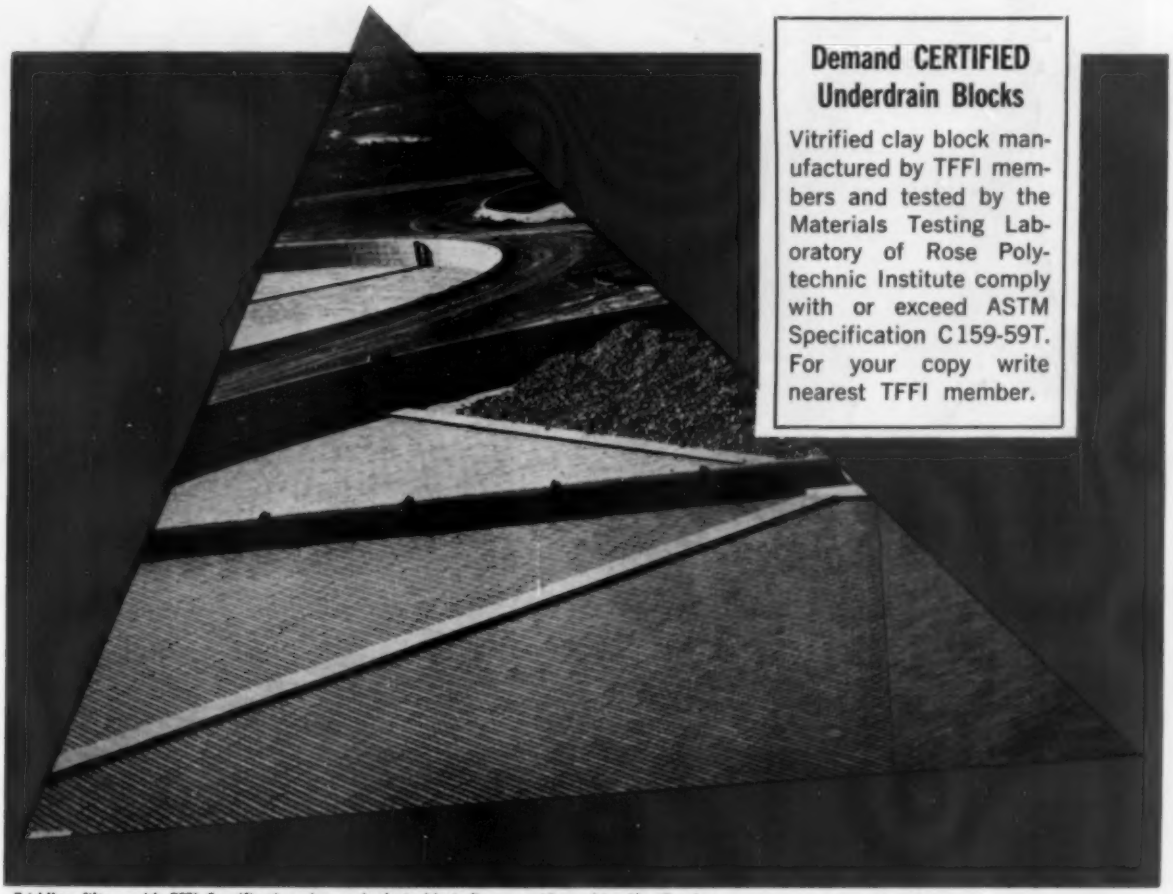
Trickling Filters: first step to clean waters

TFFI

Engineers designing new sewage and industrial wastes treatment works will gain useful data and specifications-suggestions from the 1959 Trickling Filter Floor Institute Handbook. It also indicates the economy, efficiency and ease of future expansion inherent in this type of plant. If you lack a copy just ask your nearest TFFI member for one; without obligation, of course.

Why TFFI Specification Underdrains Excel

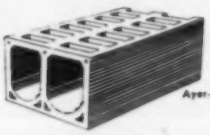
Made of vitrified clay, the best known material for resisting the ravages of acids, alkalis and bacteriological action, they insure long, satisfactory service. They protect against possibilities of costly future trouble in tearing up filter floors to replace deteriorated substitute materials. Rigid quality controls in manufacture that cannot even be approached by substitutes, plus a 50-Year Guarantee that only clay can offer, are your assurance that in the years ahead the *first* cost of TFFI clay floors will be the *only* cost.



Demand CERTIFIED Underdrain Blocks

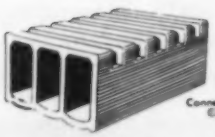
Vitrified clay block manufactured by TFFI members and tested by the Materials Testing Laboratory of Rose Polytechnic Institute comply with or exceed ASTM Specification C159-59T. For your copy write nearest TFFI member.

Trickling filters with TFFI Specification clay underdrain block floors at Alexandria, Va. Greeley & Hansen, Consulting Engineers; James McHugh Construction Company, General Contractors.



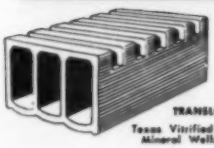
ARMCO
Ayer-McCord Clay Co., Inc.
Brazil, Ind

DICKEY
W. S. Dickey Clay Mfg. Co.
P.O. Box 2038
Kansas City 42, Mo

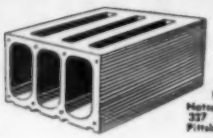


TRANSLOT
Connelton Sewer Pipe Co.
Connelton, Indiana

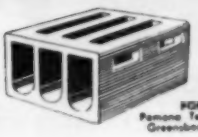
Trickling Filter Floor Institute



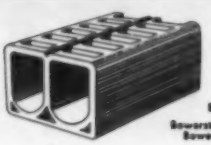
TRANSLOT
Texas Vitrified Pipe Co.
Mineral Wells, Texas



NATCO
Natco Corporation
327 Fifth Avenue
Pittsburgh 22, Pa



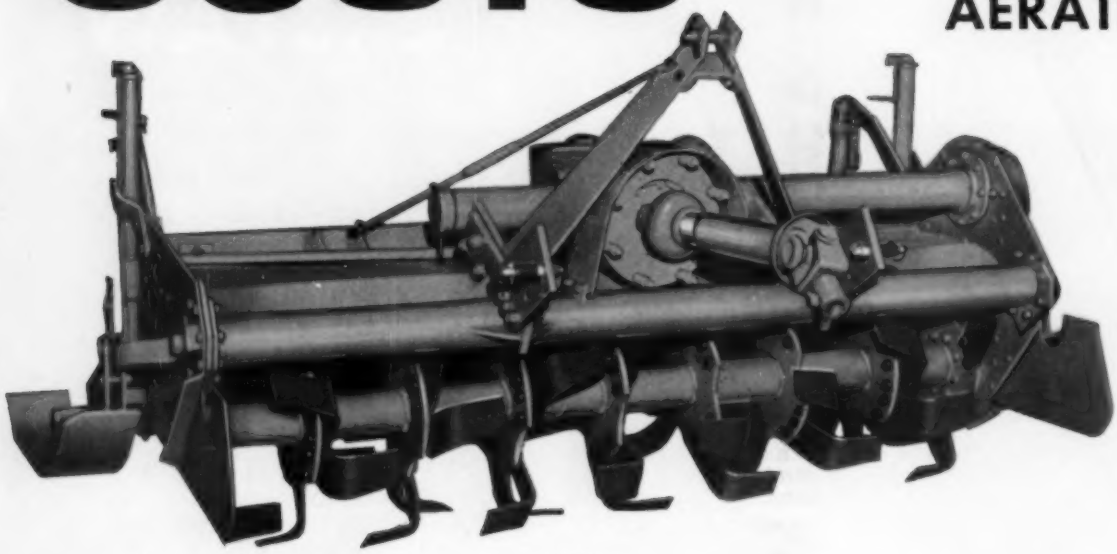
HOMOSA
Pomona Terra-Cotta Co.
Greensboro, No. Car



BOSCO
Bowerston Shale Co.
Bowerston, Ohio

CUT COSTS

MIX
PULVERIZE
RECLAIM
AERATE



NEW *Mix-in-Place* ECONOMY

The *all new* Howard UNIMIX is the low cost answer for mixing and pulverizing jobs of the contractor, developer or local government. UNIMIX is a power take-off blender-pulverizer designed to work off modern tractor power in the 55-80 h.p. class . . . the same power package now used for back-hoe and front end loader work.

Why pay *three*, *four* or *five* times more for self-propelled, single purpose blending equipment only to have it at expensive rest when the jobs are completed?

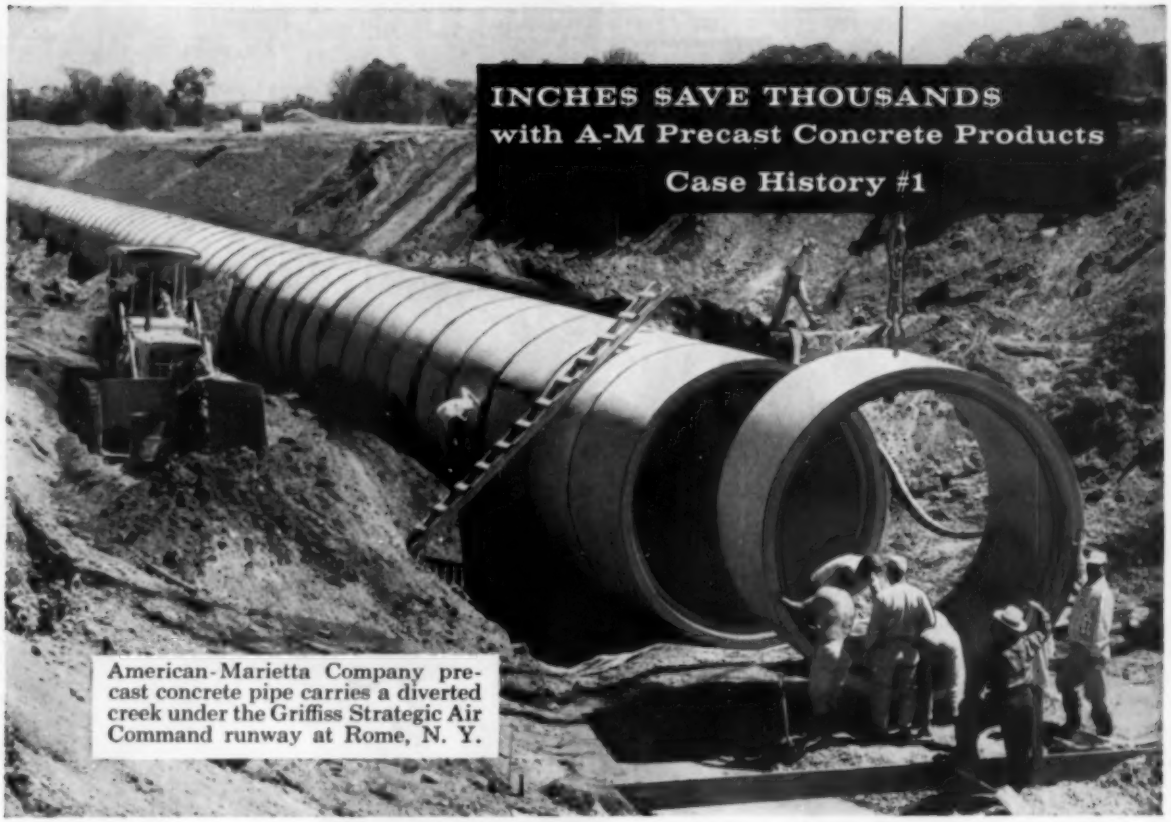
The UNIMIX is versatile . . . Mix and blend; pulverize and reclaim; add moisture for better compaction; aerate soil to speed production; strengthen bases and sub-bases with any additive and clear land.

Write today for literature and demonstration facts.

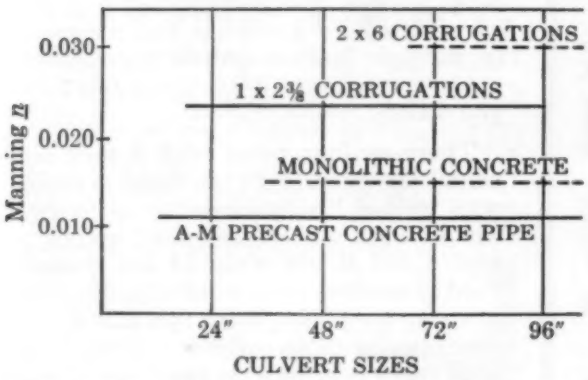
UNIMIX 80 mounted on Massey-Ferguson 85 (butane) tractor. City street reclamation in Amarillo, Texas using dry lime.

HOWARD unimix

Industrial Division • HOWARD ROTAVATOR CO., INC. • Harvard 3, Illinois


INCHES SAVE THOUSANDS
with A-M Precast Concrete Products
Case History #1
American-Marietta Company precast concrete pipe carries a diverted creek under the Griffiss Strategic Air Command runway at Rome, N. Y.

SMOOTHER SURFACES OF A-M CONCRETE PIPE CUT COSTS $90,000



ROUGHNESS COEFFICIENTS.–PROVEN BY TESTS

- Concrete pipe saved the U. S. Government more than $90,000 through more efficient, smaller sizes that are more easily installed.
- Precast concrete pipe will continue to serve year after year as a permanent structure virtually free of maintenance.
- Precast concrete pipe speeds and simplifies construction without fear of flotation, displacement or seepage.
- Precast concrete pipe eliminates hazards of inflammable coatings.

AMERICAN-MARIETTA COMPANY
CONCRETE PRODUCTS DIVISION
GENERAL OFFICES:
AMERICAN-MARIETTA BUILDING
101 EAST ONTARIO STREET, CHICAGO 11, ILLINOIS, PHONE: WHITEHALL 4-5600

SAVE $414 per truck IN THE FIRST YEAR!

NEW FORD ECONOLINE VANS

Now, *you can save $312 to $433 in price* alone* on a Ford Econoline Van compared to old-style half-ton panels. In addition, you can save over $100 every 16,000 miles you drive!

These savings come with a man-size truck. The Econoline's cab-forward design with welded "body-frame" gives bridge-like strength and reduces dead weight to haul a full ¾-ton. Only 14 feet overall, Ford Econolines are nimble in traffic, easy to park, need less garage space. Big 4-ft. door opening (both curbside and rear) and level cargo floor provide new loading ease . . . new load workability.

Special Note To Pickup Owners: Now, you can protect your loads from weather and theft with an Econoline Van . . . yet, pay less* than for most conventional ½-ton pickups. And you can get the same $102 savings on operating expenses as shown at the right.

**Based on a comparison of latest available manufacturers' suggested retail prices*

HERE'S HOW YOU SAVE

SAVINGS ON OPERATING EXPENSES EVERY YEAR!

GAS Econoline trucks can give 30% better gas mileage than conventional ½-tonners. Figuring 16,000 miles per year at prevailing gas prices, you save..... **$70**

OIL—Crankcase capacity is only 3½ quarts instead of 5 quarts, and the recommended oil change interval is 4,000 miles versus 2,000 miles. In 16,000 miles you save..... **$13**

TIRES—Econoline tires last longer, cost less to replace. Prorated saving for 16,000 miles as high as $53. Typical saving..... **$16**

LICENSE—In many states (not all) the license for an Econoline costs appreciably less—up to $30.40 per year. Average for all states is..... **$3**

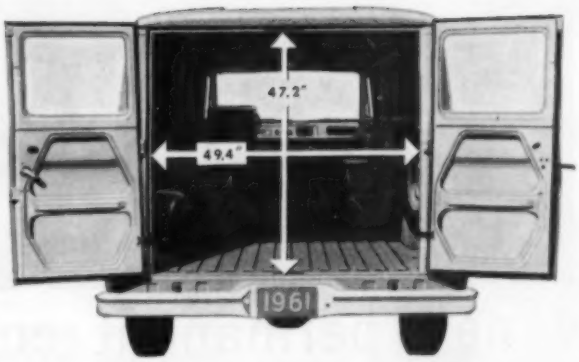
$102

SAVING ON PRICE—You can save $312 compared to even the lowest-priced conventional ½-ton panel—and up to $433 against others! Saving at least..... **$312**

TOTAL FIRST YEAR SAVINGS... $414

and you keep saving

$102 EVERY YEAR!



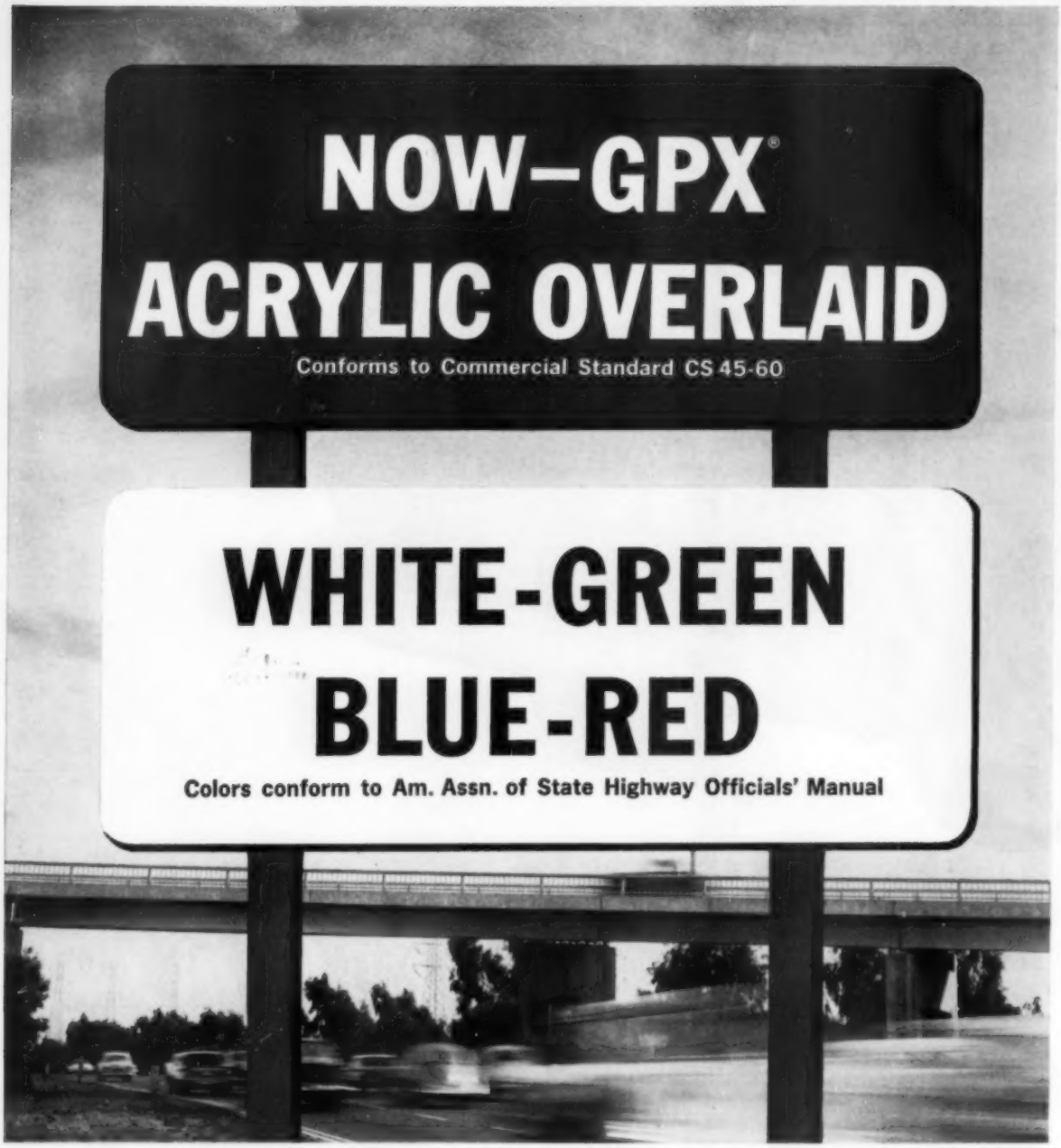
NO REAR ENGINE HUMP!

The Econoline's "up front" engine leaves a level, knee-high floor almost 9 ft. long. There's no awkward rear-engine-housing hump to shrink the back entrance or hinder loading. And the Econoline Van provides over 204 cu. ft. of loadspace . . . up to 57 cu. ft. more than conventional ½-ton panels.

FORD TRUCKS COST LESS

SEE YOUR FORD DEALER'S "CERTIFIED ECONOMY BOOK" FOR PROOF!

FORD DIVISION, Ford Motor Company



4 new permanent colors in GPX plywood

- GPX is now available with acrylic overlay . . . in permanent colors of green, white, blue or red. Order it in any combination of colors front and back, or with natural or black high density one side.
- Resists severe weather and abuse. Won't rust or corrode. Can be fabricated with woodworking tools. GPX costs less, lasts longer than metal. Reflective sheeting bonds better to overlaid plywood surface.
- Strong, stiff panels light, easy to handle. Require minimum backing and framing.
- 1-piece panels up to 60" x 120", larger scarfed panels also available.
- Write today for free sample, complete data.

GP
GEORGIA-PACIFIC

Dept. PW561, Equitable Building, Portland, Oregon • plywood • lumber • redwood • hardwood • pulp • paper • chemicals

Trench under the track?
...easy job with a John Deere!

Needle-threading precision is standard performance for John Deere Backhoes with two-lever control. Boom, bucket, and dipper-stick functions are always right in the operator's hands—an important feature which provides fast working speeds, smooth operation. Instant-response hydraulics assure deft control.

Two John Deere Backhoes, the center-mounted 50 and five-position 51, are available to meet the many varied needs of municipal street departments. When mounted full left or full right as required, the 51 makes it possible to trench flush along building foundations, walls, or fences. The mounting position of the rotary boom cylinder is easily changed in the field by one man, using only a wrench and the backhoe's hydraulic power.

John Deere Backhoe combinations are now offered with the 40 h.p. "1010" Crawler or Wheel Tractor, and the new "3010" Wheel Tractor with 64 h.p. gasoline or 69 h.p. Diesel engine.

For full specifications and a demonstration, contact your John Deere dealer now through the yellow pages of your telephone directory. John Deere, 3300 River Drive, Moline, Illinois.

JOHN DEERE

LOADERS
BULLDOZERS
BACKHOES
AND
CONSTRUCTION
EQUIPMENT

"Call FOSTER... get Line Pipe PLUS"

When you need large diameter pipe, especially 12¾" thru 48", L. B. Foster Co. can supply all you need from any one of its seven nationwide warehouses. And where's the "plus"? It's the "Faster From Foster" service that speeds your order.

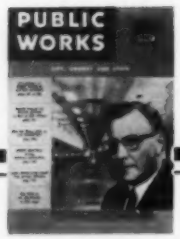
As one of the country's major pipe specialists, Foster offers a one stop source to water works engineers and superintendents for municipal and industrial line pipe. This includes bare pipe and "controlled-quality" coating and wrapping—or lining—up to 78" diameters, and to all standard specifications.

Also, check Foster for savings on Structural Grade pipe—ideal for non-pressure use, and for water well casing and pump columns.

Write **L. B. FOSTER CO.** for Stock List PW-5, Pittsburgh 30, New York 7, Chicago 4, Houston 2, Los Angeles 5, Atlanta 8, Cleveland 35.

Faster From Foster

Pipe · Valves · Fittings · Piling · Rail



Charles V. Roberts, 1961 President of The Water and Sewage Works Manufacturers Association and former member of the Board of Directors of the AWWA, is president of the Roberts Filter Manufacturing Company of Darby, Pa., and the Roberts Filter Company of Canada Ltd., Toronto. After graduation from Ursinus College he joined Roberts Filter as the third generation member of a company started by his grandfather in 1897, assuming the presidency in 1935. Two of Mr. Roberts' brothers are also active in the company.

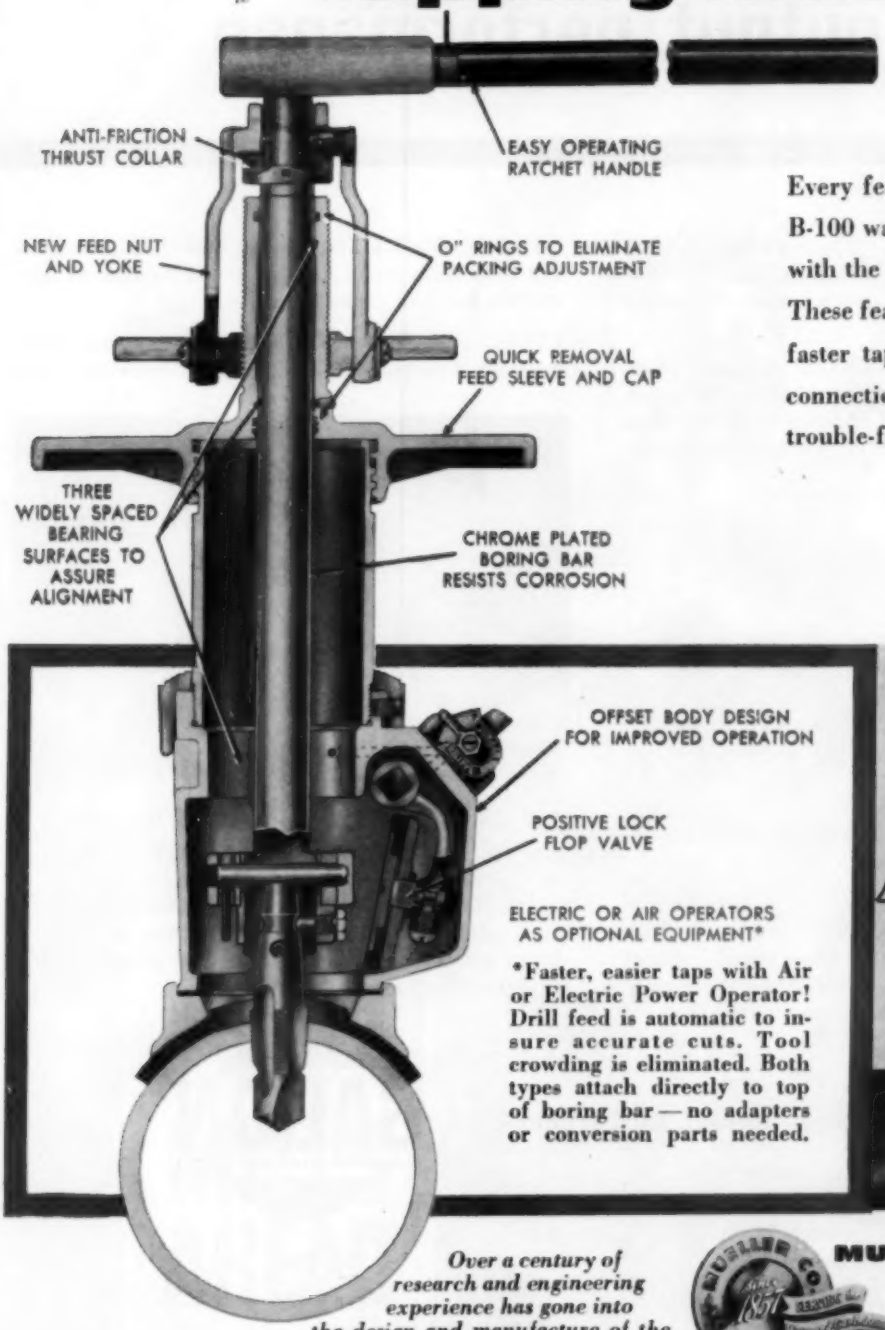
Roberts Filter is engaged in all aspects of water treatment —as engineers, manufacturers and installers, and Mr. Roberts has traveled extensively throughout the USA, Canada, Central and South America, and the Caribbean area in connection with the many water treatment installations made by his company.

He is a member of numerous technical societies and associations including the WPCF and the IAASE; is a director of the Delaware County Manufacturers Association; a director of a local bank; and on the board of several industries in the Delaware Valley.

He and his wife, Frances, have five children—Pamela, a sophomore at Allegheny College; Charles III, soon to enter Davidson College; Robert Lee; Sherman; and Delight. The time he has for relaxing is spent at his summer place on the Eastern Shore of Maryland and in pursuit of his hobbies, photography and boating. Also he devotes much time to civic, fraternal and religious activities including Rotary International, Boy Scouts, Masonry and the Shrine. He is a trustee for the Conwell School of Theology, the Darby Library Board, Ursinus College and the Sharon Hill Methodist Church.

operators like the ease . . .
the speed . . . the accuracy of the new

MUELLER B-100 tapping machine!


ANTI-FRICTION THRUST COLLAR
EASY OPERATING RATCHET HANDLE
NEW FEED NUT AND YOKE
O" RINGS TO ELIMINATE PACKING ADJUSTMENT
QUICK REMOVAL FEED SLEEVE AND CAP
THREE WIDELY SPACED BEARING SURFACES TO ASSURE ALIGNMENT
CHROME PLATED BORING BAR RESISTS CORROSION
OFFSET BODY DESIGN FOR IMPROVED OPERATION
POSITIVE LOCK FLOP VALVE

Every feature of the new B-100 was designed with the operator in mind. These features give you faster taps, pressure-tight connections and easy, trouble-free operation.

ELECTRIC OR AIR OPERATORS AS OPTIONAL EQUIPMENT*

*Faster, easier taps with Air or Electric Power Operator! Drill feed is automatic to insure accurate cuts. Tool crowding is eliminated. Both types attach directly to top of boring bar — no adapters or conversion parts needed.

Over a century of research and engineering experience has gone into the design and manufacture of the B-100 Drilling, Tapping and Inserting Machine.

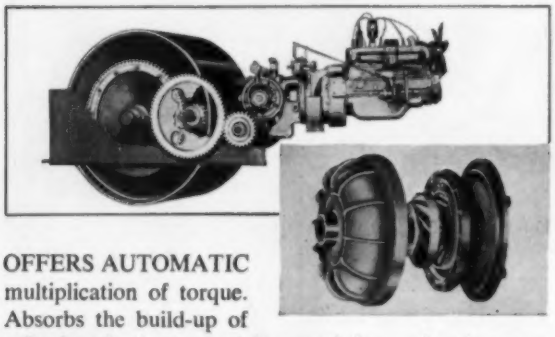
MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles; in Canada: Mueller, Limited, Sarnia, Ontario.

You'll profit most when you standardize on GALION ROLLERS AND GRADERS. They're equipped for high-output performance

YOU'LL FIND USERS very enthusiastic about Galion "Miles Ahead" performance on any grading and compacting job. Let's look at two Galion features that assure exceptionally good results.

THERE'S ROLL-O-MATIC DRIVE . . . standard on Galion rollers. A highly efficient combination of torque converter, tail-shaft governor and two-speed transmission that gives you important savings in time and dollars.



OFFERS AUTOMATIC multiplication of torque. Absorbs the build-up of roller inertia. Assures quick, smooth forward-and-reverse action. Saves time.

AUTOMATIC POWER application is another Roll-O-Matic advantage. Permits an infinite number of drive ratios—from top speed to creep-along travel—without overloading or stalling engine. Roll-O-Matic Drive cushions shock loads—prevents wear—saves maintenance.

GRADE-O-MATIC DRIVE, the Roll-O-Matic equivalent for Galion motor graders, is the ultimate in fast, smooth, low-cost grader operation.

EFFECTIVE WORKING SPEED is regulated automatically. Operators benefit by smooth shockless power

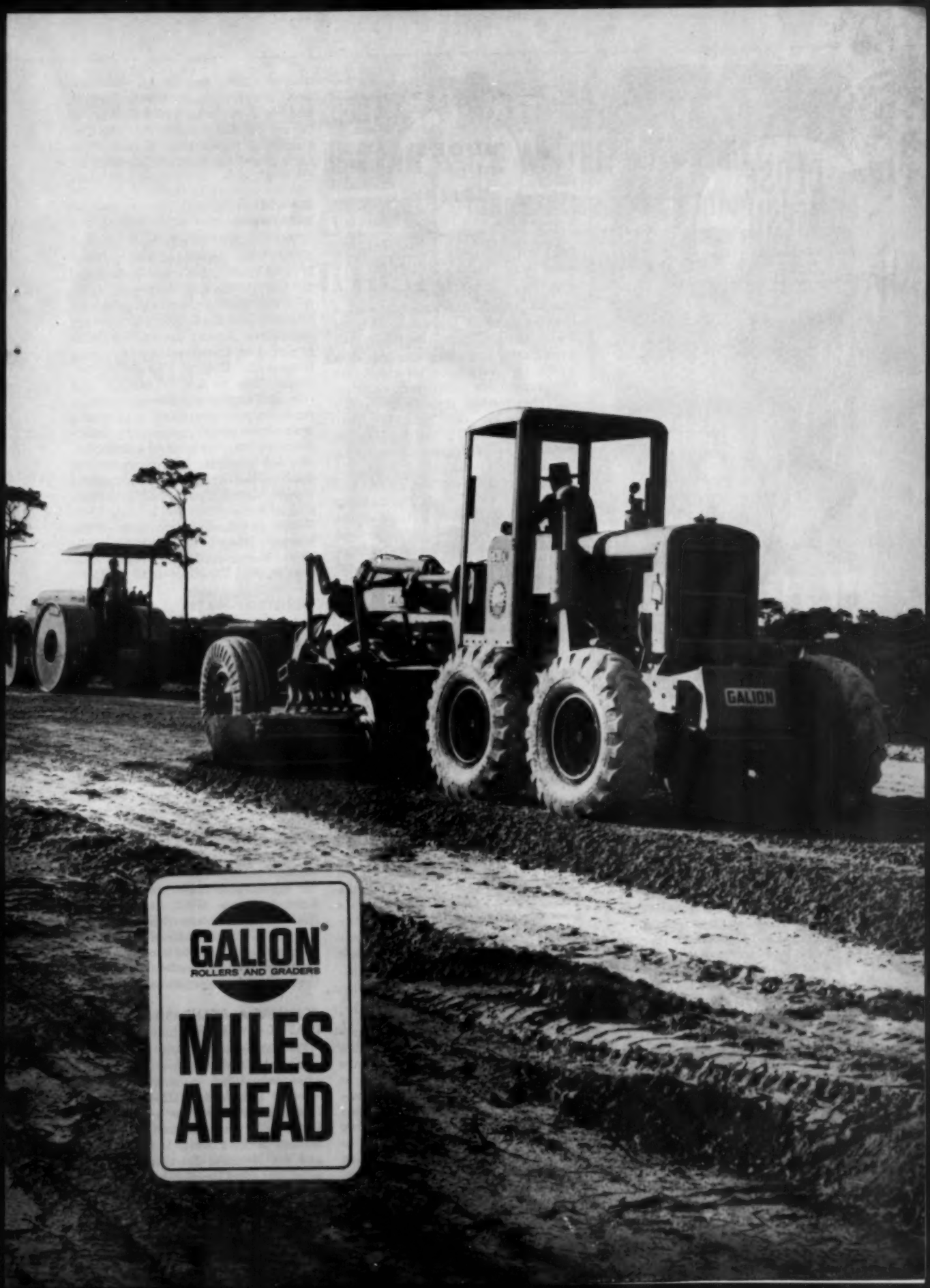
transmission without lugging or stalling. They're free to concentrate on more efficient blade work and get more work done.

For information on Grade-O-Matic and Roll-O-Matic equipment contact your Galion distributor or write for latest catalog data. The Galion Iron Works & Mfg. Company, Galion, Ohio, U.S.A.

THE GALION IRON WORKS & MFG. COMPANY, GALION, OHIO, U.S.A.

GALION®
ROLLERS AND GRADERS

General and Export Offices, Galion, Ohio, U.S.A.—Cable Address, GALIONIRON, Galion, Ohio


GALION
ROLLERS AND GRADERS
MILES
AHEAD
GALION

CLOSE MESH
IRVICO Gratings are made in an exceptionally close mesh with bearing bars spaced ¼" face to face.
WIDE MESH
IRVICO Gratings are also made in an unusually large mesh with bearing bars spaced as much as 6" face to face.

New frontiers in grating design

The many new uses for grating that have been developed and are being explored require an increasing number of mesh designs and sizes. IRVICO now produces 147 different mesh designs for an enormous variety of industrial, architectural and decorative applications...with more to come for new uses and conditions.

"A FITTING GRATING FOR EVERY PURPOSE"
Catalog on request

IRVICO

IRVING SUBWAY GRATING CO., Inc.
Originators of The Grating Industry Est. 1902
Offices and Plants at:
5053 27th St., LONG ISLAND CITY 1, N.Y.
1853 10th St., OAKLAND 20, CALIFORNIA

PARKING LOT MANUAL

This is a comprehensive, 40-page manual titled "How to Lay Out a Parking Lot." It takes into account the dimensions of all 1960 and 1961 model cars, including the compacts which can be placed effectively in reserved areas. Detailed sketches and photographs provide a variety of parking lot plans, including layouts for parking at 90 degree, 60-degree, and 45-degree angles, with recommended individual stall dimensions, aisle widths, and entrance and exits sizes. Parking lot patterns described in detail include straight row parking, perimeter and island parking, slanted stalls, herringbone pattern parking, and v-shaped patterns. Minimum space requirements are provided for specialized parking lots serving differing facilities, such as amusement centers, stores, stadiums, banks, bowling alleys, churches, offices, hospitals, hotels, factories, night clubs and theaters. Sent on request to Western Industries, Inc., Parking Gate Division, 2742 West 36th Place, Chicago 38, Ill.

NATIONAL CONFERENCE ON WATER POLLUTION

The proceedings of the National Conference on Water Pollution, held in Washington, D. C., Dec. 12 to 14, have been published. There are 600 pages. The Government Printing Office lists the price at $2.25 but the Public Health Service reports that some copies are available, while they last, from the National Conference on Water Pollution, 4216 South Building, Washington 25, D. C.

OHIO HIGHWAY ENGINEERING CONFERENCE

This publication contains the papers presented at the 1960 Ohio Highway Engineering Conference which was held in April, 1960, at The Ohio State University. It contains 27 papers on nearly all phases of highway engineering, including four on pavement surfaces; two on bridges; eleven on construction management, opportunities for engineers, safety and highway needs; one on traffic; and six on construction techniques of bases, flexible and rigid surfaces and bridges, 241 pages; Special Report No. 16; Engineering Experiment Station, The Ohio State University, Columbus 10, Ohio. $3.50.

SEWAGE TREATMENT

The sub-title of this book emphasizes "basic principles and trends" It is an English book and is designed for use by working managers, foremen and assistants on sewage works, students and municipal and sanitary inspectors. Rather special emphasis is placed on the chemistry of sewage treatment. Chapter headings include: The nature of sewage and chemical analysis; sewerage systems, storm water overflows and storm water treatment; preliminary treatment; primary processes; aerobic biological methods; improvement of final effluents; sludge; industrial wastes; small plants; and a discussion of trends. The authors are R. L. Bolton and Louis Klein, both of the Mersey River Board. 156 pages; $5.50. Butterworth, Inc., 7235 Wisconsin Ave., Washington 14, D. C.

INDUSTRIAL WATER USE IN ILLINOIS

An 8-page reprint from the Proceedings of the American Power Conference presents a paper by W. J. Roberts of the Illinois State Water Survey. This summarizes industrial water use and the sources of supply. Illinois State Water Survey, Urbana, Ill.

OPERATION CRYOGENICS

This 66-page booklet, extraordinarily well prepared, reports on the program of study to demonstrate the suitability of 9 percent nickel steel for application under temperatures down to minus 320°F. International Nickel Co., Chicago Bridge & Iron Co. and U. S. Steel Corp. sponsored the work. We believe a copy can be obtained by application to any of the sponsoring companies.

COMMERCIAL STANDARD FOR PLASTIC SEWER PIPE

Developments within the plastic sewer pipe industry are reflected in a recommended revision of Commercial Standard CS228-60, Plastic Drain and Sewer Pipe and Fittings. Prepared in cooperation with The Society of the Plastics Industry, Inc., and the National Bureau of Standards, by the Commodity Standards Division, Office of Technical Serv-

ices, Business and Defense Services Administration, U. S. Department of Commerce, the recommended revision was recently submitted to the industry for consideration and acceptance. Essentially, the revision provides a means of broadening the application of plastic drain and sewer pipe to include larger sizes of pipe for use in sanitary and storm sewers. Limited copies of the recommended revision, designated TS-5527, are available on request from the Commodity Standards Division, U. S. Department of Commerce, Washington 25, D. C.

PALISADES DAM and POWER PLANT

This is a detailed record of the planning, design, construction and initial operation of the Palisades Dam and Powerplant, a multiple purpose reclamation project in Idaho. The dam is 270 ft. high, earthfill, with a volume of more than 13 million cu. yds. Power capacity is 114,000 kw. Many design drawings and photographs of construction; 535 pages; $10. Code 841, Bureau of Reclamation, Bldg. 53, Denver Federal Center, Denver 25, Colorado.

Letter to the Editor

NAVY PUBLIC WORKS

As a career employee in the public works program of the Navy and a Reserve officer in the Civil Engineer Corps, I note with satisfaction and with pride the selection, as one of the Top Ten Public Works Men-of-the-Year, of Rear Admiral E. J. Peltier, CEC, USN, our Chief of Civil Engineers.

In view of the widespread operations and ever-increasing scope of Federal participation in the public works field, I have often wondered why you have not given recognition of this by modifying your traditional and very effective masthead to read something like "CITY, COUNTY, STATE AND FEDERAL."

If there is no particular reason why this should not be done, I feel that many other faithful readers, such as I, would experience a small glow of warmth at being included "in the family" with all the others employed in and dedicated to the public service.

D. R. Dorsey
Mgr., Civil Engineering Branch
District Public Works Office
Fifth Naval District
Norfolk 11, Virginia

KING SIZE METER does double duty at Orange County sanitation plant

Consulting engineer:
J. A. Corollo, Phoenix, Arizona

Measure-Rite's 78-inch giant measures water... paces chlorination to rate of flow

This 78" Measure-Rite meter handles two big jobs at Orange County's new sanitation district in Santa Ana, California:

- it measures final effluent on the outfall line from the sewage treatment plant
- by means of an attached electro-pneumatic transmitter, it sends out air signals proportional to rate of flow to pace chlorination at one of the largest stations ever built

Measure-Rite worked with Orange County engineers to install the giant meter without any shutdown of the flows, waiting till tide conditions were lowest. The successful installation will be duplicated within the next two years, when the project will be completed.

Orange County is typical of Measure-Rite's ability to custom-tailor meters to special requirements. Propeller meters — featuring the free-flow design — are also available for jobs up to 250 psi. Write for descriptive literature.

Send for Bulletin MR-105 describing Measure-Rite's complete line of propeller meters

Badger Meter Mfg. Company
MEASURE-RITE DIVISION
4545 W. Brown Deer Rd. • Milwaukee 23, Wisconsin

Don't Gamble...
with your
community's finances
and future...
GLOW

you KNOW
CLOW
cast iron pipe
will last over 100 years

Can you risk the high cost of buying substitutes "at a price"? CLOW cast iron pipe assures dependable water service...now and for the future. The first cost is the *last* cost. Only tough, rugged cast iron pipe combines proven long life, trouble-free service, and sustained high-carrying capacity at low cost. Can you afford to buy less? Before you buy, let us prove to you that CLOW cast iron pipe is the best value for your job.

CLOW manufactures a complete line of cast iron pipe, fittings, valves, fire hydrants and piping specialties for every waterworks installation. Write or call today.

CLOW CAST IRON PIPE

JAMES B. CLOW & SONS, INC.
201-299 North Talman Avenue, Chicago 80, Illinois

Subsidiaries:
Eddy Valve Company, Waterford, N.Y.
Iowa Valve Company, Oskaloosa, Iowa

Clow Cast Iron Pipe Plants are located at
BENSENVILLE, ILLINOIS • BIRMINGHAM, ALABAMA • COSHOCTON, OHIO

C-E shows

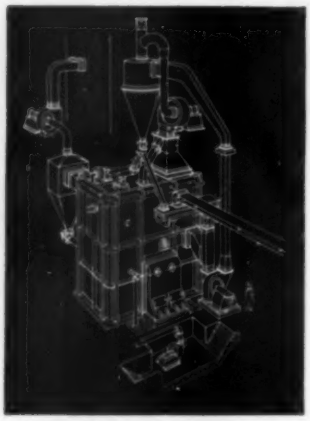
how one plant can handle 2 types

with considerable savings in

More and more communities—large and small—are looking into the possibilities of treating both refuse and sewage sludge at the same plant site. Aside from the obvious savings in land acquisition costs, the dual function plant offers many other benefits. Manpower and equipment can be combined to eliminate costly duplication. And the heat generated in burning either refuse or dried sludge can be used as an economical source of steam for heating or power merely by adding a C-E Waste Heat Boiler to the outlet end of the incinerator. This *is no cost heat.*

Heart of the C-E 2-in-1 disposal system is the C-E Traveling Grate Incinerator Stoker. Using "continuous processing" the C-E Incinerator Stoker requires only minimum attention and maintenance. Refuse (alone, or mixed with dried sludge) is fed into the self-sealing, non-clogging hopper. It is reduced to a sterile ash, free from clinkers and automatically discharged to the ash pit. This ash is suitable for use as a sanitary land fill.

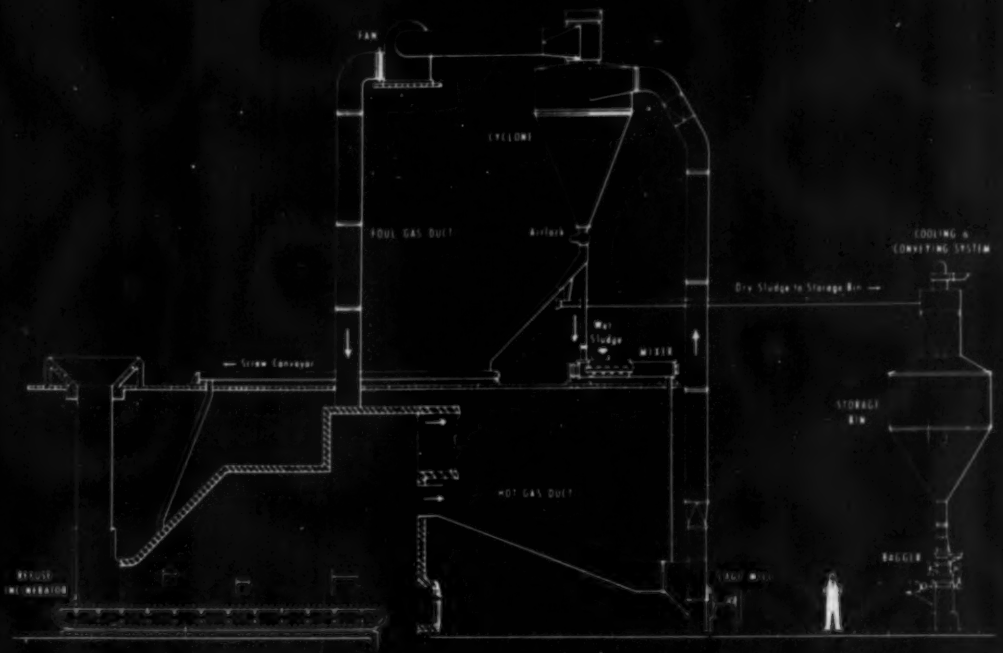
Heat from the burning waste is used to dry sludge in the C-E Raymond Flash Dryer. This service-proved equipment provides high temperature deodorization and efficient fly ash collection. The dried sludge can then be incinerated to provide heat for further sludge drying, or can be used as a soil conditioner — in parks or recreation areas, or for sale to gardeners.



FOR SLUDGE DISPOSAL ALONE, the C-E Raymond Flash Drying and Incinerator System permits both drying and incineration of sewage sludge —separately or together—in any proportion. Where combined sewage and refuse disposal is not feasible, this system provides maximum efficiency in processing filter cake.

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

# of waste disposal { 1 refuse... 2 sewage sludge



C-E 2-in-1 REFUSE AND SEWAGE DISPOSAL SYSTEM

This system combines over 50 years' experience in burning every kind of marginal and waste fuel with a drying system that today processes more filter cake than all other systems combined. The entire operation is automatic, efficient, quick and clean. Capacity per dollar of plant investment is increased. Manpower requirements are minimal. The system is capable of burning all types of combustible refuse in quantities ranging upward from 50 tons per 24-hour day.

COMBUSTION C-E ENGINEERING

General Offices: Windsor, Conn. • New York Offices: 200 Madison Ave., New York 16 C-302

Raymond Division: 427 West Randolph St., Chicago 6, Ill. • Western Office: 615 So. Flower St., Los Angeles 17, Cal.

Canada: Combustion Engineering-Superheater Ltd.

PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

The 2 yd. 185 HP (flywheel) 944 Traxcavator—Proven by seven years of testing and widely accepted after a year in the field, this machine offers the Cat power shift transmission for instant shifting, forward and reverse, 1st and 2nd speeds. Other wheel loaders include the 2¾ yd. 966 and 1¼ yd. 922. Also available is a line of track-type loaders; the 2½ yd. 977, the 1¾ yd. 955, and the 1⅛ yd. 933.

CATERPILLAR REPORTS

HOW TO GET MAXIMUM MACHINE VALUE THROUGH BEST BID BUYING

Many communities have laws requiring lowest bid buying. Unfortunately, this intended protection of public funds collapses when applied to construction equipment.

Supervisor Bernard Amell, of the Plattsburgh, N. Y., Town Board, explains the realities of equipment buying this way: "The accepted machine cost figure must include not only the initial price tag but also the more important items such as fuel and oil consumption, ease in servicing, maintenance costs, final trade-in value, and source of replacement parts and service to eliminate down time. Failure to include these charges is hiding the true costs of the machine from the public."

When all these factors *are* included, this is Best Bid buying. It's Best Bid because it's real; it's Best Bid because the lowest *total* cost is best for taxpayers.

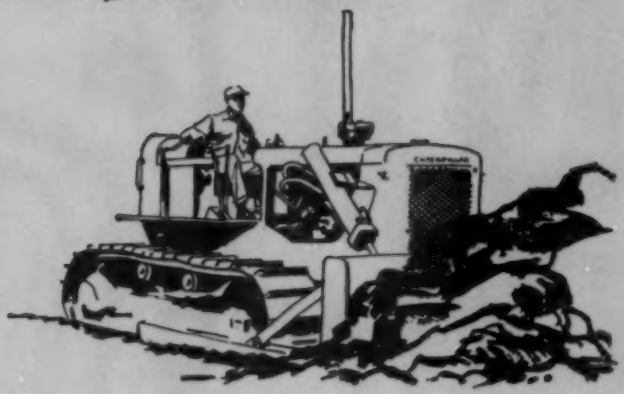
HERE ARE REPORTS FROM COMMUNITIES WHO BOUGHT ON BEST BID BASIS:

Vermont Division of Highways When this state organization began keeping records on two motor graders purchased in 1950, they found that the machine that cost more initially proved to be the best buy in the long run because it cost nearly $8000 less to operate over a nine-year period.

Harrison County, Indiana Accurate, by-machine cost records showed that a year-old Cat No. 12 Motor Grader required only a set of head gaskets and two spark plugs, with $25 labor, in one year. Two new machines of another make required major engine repairs, new clutches and side shift linkage during the same period.

Plainview, Texas This city kept operating costs on a Cat No. 212 Motor Grader and found that it

The 100 HP No. 112F—This new turbocharged motor grader will earn its keep in constant availability and low operating costs. It features the proven oil clutch which gives up to 2000 hours of operation without adjustment. The No. 112F is one of the four models available from 85 to 150 HP.



The 93 HP D6B Tractor—Featuring a Cat D333 Engine with unusually high lugging ability, this versatile tractor typifies the quality of Caterpillar-built equipment. The proven oil clutch, dry-type air cleaner, and lifetime lubricated track rollers help keep this one on the job with a minimum of servicing. Caterpillar's range of five tractor sizes extends from 52 HP through 335 HP.

cost only $100 for repairs over five years. On a Best Bid basis, they recently bought a Cat 955 Traxcavator.

Escambia County, Florida Machines purchased on a Low Bid could not be put back in operation quickly because it took a week or longer to get parts. Now, buying on a Best Bid basis, city officials feel the savings in upkeep will more than offset the initial price differences.

Dallas County, Texas Purchasing agents awarded the purchase contract to the highest bidder. They bought the higher price machines when the records proved that the low-price machines would cost over $12,000 more to operate over a ten-year period.

Plattsburgh, New York In addition to the long life of Caterpillar equipment, this city considers immediate availability of parts and services as part of the low cost of buying on Best Bid basis.

INITIAL COST • OPERATING COST
DOWN TIME • RESALE VALUE

When all these factors are taken into consideration, public and government officials all over the country have discovered that this Best Bid approach to purchasing points to Caterpillar. Some of the reasons are dependability, lower repair costs and fewer of them, top performance and high resale value of the Cat-built machines.

Individual machine cost records prove that Caterpillar equipment working on governmental jobs means more savings to taxpayers. See your Caterpillar Dealer for such records on jobs in your area. He'll also be glad to give you Time and Cost Record Books which allow you to keep individual records on your own machines.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U. S. A.

CATERPILLAR

Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

QUALITY-BUILT MACHINES —LOWEST TOTAL COST

"IMMEDIATE maintenance savings–that's what we got by replacing all our old signs at one time with new ones of Alcoa Aluminum!" Mayor George J. Helmsing of Shrewsbury, Mo., states further, "Our old signs were deteriorating fast, were very ugly. Ed Flavin and I knew we could stop this by using aluminum signs and the recommended reflective sheeting. Ed made the pitch to Council."

"We went the way of St. Louis County," added Street Commissioner Ed Flavin. "I got several bids on sign materials . . . all types and shapes. We looked at samples and the Alcoa jobber gave us a lot of help.

"The aluminum signs were competitively priced," Mr. Flavin continued, "and with the additional savings in upkeep and maintenance, there was no question as to which of the sign materials would be better."

"Aluminum signs never rust . . . stand

Police Chief Fred J. Huncke points with pride to a new stop sign of Alcoa Aluminum—one of many such signs installed by the City of Shrewsbury, Mo. Street Commissioner Edmond Flavin, Sr., and Superintendent of Public Facilities Joseph Klausner look on approvingly.

weather much better," added Chief of Police Fred J. Huncke and Superintendent of Public Facilities Joseph Klausner. "Every two years, old signs had to be removed, sanded and repainted. With aluminum—put it up and it stays!"

The program was approved unanimously.

This is a true story. The facts are there. Following the example set by St. Louis County, the City of Shrewsbury voted to replace immediately *all* their street and stop signs with signs of Alcoa® Aluminum. And even though we couldn't make the presentation ourselves, we thank Ed Flavin for the fine selling job.

Call your nearest Alcoa sales office and learn how your community can stretch tax dollars with Alcoa Aluminum Street and Stop Signs . . . and at the same time qualify for the big FREE Alcoa "Welcome to Your Town" sign. Or write: Aluminum Company of America, 897-E Alcoa Building, Pittsburgh 19, Pa.

ALCOA ALUMINUM

HIGHWAY PRODUCTS

POWERFUL, FAST NEW

As a bulldozer

You can power-tilt either corner of the husky 7'4" blade as much as 13", on-the-go, to speed grubbing work, start side-hill cuts, dig desired ditch-angle on first pass — even in hardpan!

As a tractor-shovel

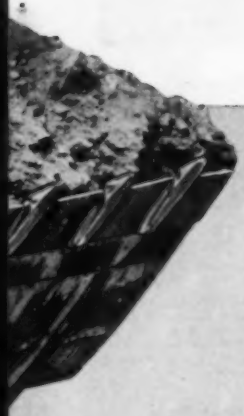
Rugged 1¾ cu yd (1½ yd SAE) self-leveling bucket develops 11,200 lbs breakout force, 8-ton lift capacity. Provides over 8-ft dump clearance, with 34" forward reach at maximum lift, for fast loading of big trucks.

As an angling dozer

Wide 9'4" blade can be power-angled 25° right or left, at the touch of a lever. Doubles dozing output by side-casting with full blade on every pass, with no "dead" back-up time. Matching winch, 3 or 5-tooth ripper available.

CASE® 750

FOR MEDIUM-HEAVY WORK



PROVEN FEATURES TO HELP YOU HANDLE MORE JOBS, MORE PROFITABLY

- **Powerful CASE-Built Diesel** — proved by 15 million hours of field use . . . delivers 72 gross hp* with unmatched fuel economy . . . insures dependable all-weather starting.
- **Power-Boosting Torque Converter** increases push-pull power to 23,000 lbs**, adjusts infinite speed ratios to changing loads AUTOMATICALLY . . . without clutching, shifting or engine stalling.
- **Job-Proved Terramatic® Transmission,** constant mesh type, provides full power-shifting, with 4 forward and 4 reverse speeds to 6.6 mph — *plus* independent power and speed control of each track for increased maneuverability.
- **Exclusive "Constant-Command" Control** of every operation, every minute of the day . . . faster, safer, easier. No hand-crossing. No foot-hopping.
- **Exclusive Torsion Suspension** — with lateral stabilizers, provides better traction, smoother cuts; equalizes track loads for longer life.
- **Longer-Wearing Track System** — proved in the field over thousands of hours of operation . . . does 50% more work than conventional crawlers, on one set of tracks.
- **New Concept in Serviceability** — cuts field servicing time with exclusive swing-out radiator grille, easily-reached filters, dipsticks, drains. Automatic roller lubrication and hydraulic track adjusters save time and track wear.

**Mfrs rating* ***Assuming adequate traction*

SEND FOR FREE 16-PAGE CATALOG

HOT OFF THE PRESS!

J. I. Case Co.
Dept E1341, Racine, Wis.

☐ Send new 750 Tractor Catalog

Name .....

Title .....

Company .....

Address .....

City ..... State.....

CT-T-588

CASE®

J. I. CASE CO., RACINE, WIS.

EQUIPMENT AND MATERIALS

For Your Public Works Program

NEW LISTINGS

The engineering information in these helpful catalogs will aid you in your Engineering and Public Works programs. Just circle numbers you want on the reply card, sign and mail. This free Readers' Service is restricted to those actively engaged in the public works field of cities, counties or states.

Acid-Resistant Pipe Linings Can Be Applied in Place

29. The Centriline Process for cement-mortar linings is enlarged to include application of an epoxy-resin 100% solids system to pipe lines in place. Designed for repair and protection of concrete and vitreous sewer lines. Get literature from Centriline Corp., 140 Cedar St., New York 6, New York, or use our reply card.

Details on Utility Trenching Equipment

34. Ladder type and wheel type ditchers and trenchers are described in this newly-offered literature on utility ditchers. Described as efficient for the smallest as well as the largest trenching jobs for municipalities, counties, utilities or contractors. Full details given on performance under varying rigorous conditions. Get copies of Bulletins F-225 and F-209 from Gar Wood Industries, Inc., Wayne, Mich., or check the number on our reply card.

How to Use and Choose Cyclone Fence

40. Answers to your questions about the many ways of use and places for such fencing. Includes selection of types for your particular use. Address American Steel & Wire Div., U. S. Steel Corp., Rockefeller Bldg., Cleveland 13, Ohio, or circle our card-number.

Weed Control Deserves a Program

45. You can get a lot of valuable guidance on how to use two weed control herbicides available as wettable powders or granules to give season-long control. Get descriptive brochure GAC 630. Address Geigy Agricultural Chemicals Div., Saw Mill River Road, Ardsley, N. Y., or ring number on our card.

A Pipe Line Can be No Better Than Its Joints

46. How to get the best joints for water, sewage and other liquid service is the topic of this 12-page brochure giving advantages of "Fastite" Single Gasket Joint cast iron pipe. Full installation instructions, weights, dimensions, etc. Write for Fastite booklet to American Cast Iron Pipe Co., Box 2603, Birmingham 2, Ala., or circle card-number.

Now You Can Rent a Modern Road Roller

47. Not owning a modern roller need no longer stop you from using one. Get illustrated booklet with all details of this cost-saving rental plan by addressing The Galion Iron Works & Mfg. Co., Galion, Ohio, or you may use our reply card.

New Ring-Tite Joints on Valves and Hydrants

61. . . . are described and illustrated in new folder, for use with Transite pressure pipe. Tells how these joints eliminate need for special fittings with attendant extra labor and materials. Write for Bulletin RT-53 to The A. P. Smith Mfg. Co., 545 No. Arlington Ave., East Orange, N. J., or just circle number on card.

Lick Labor Costs With Power Truck Lifts

54. These devices on your trucks substitute mechanical for muscle power, especially suited for loading heavy discarded items. Booklet details the range of these platforms for the nine individual series of power gates, plus a combination of power gate and dump body unit. Ask for booklet PG-6005 from Equipment Div., Young Spring & Wire Corp., Bowling Green, Ohio, or check our card-number.

The Steel Pipe Line

58. New publication gives interesting highlights and pictures of many major newsworthy water line projects to show the diversity of steel water pipe use. Write Steel Plate Fabricators Association, 105 W. Madison St., Chicago 2, Ill., or check our card.

Treatment of Domestic Wastes

67. In Aerobic Digestion Plants is described in a new Bulletin of 8 pages containing a comprehensive selection guide correlating oxygenation capacity and hp. requirements for frequently used types of sewage treatment plants for 50 homes and up. Write for Bulletin No. 6650 to Yeomans, 1999 N. Ruby St., Melrose Park, Ill., or check our card-number.

Latest on Bituminous Road Construction

80. Is covered by a new 8-page booklet that discusses materials, equipment and procedures with recommendations for suitable binders for bituminous stabilization, new construction or reclamation. This brochure will bring you up to date. Ask for Bulletin No. 1032 of American-Marietta Co., Construction Equipment Div., Milwaukee 1, Wisc., or check our card-number.

A New Bio-Oxidation Aerator

73. . . . is described in this folder. Primarily for use in the activated sludge process, the Permutit Permaerator is emphasized as a high efficiency mechanical-turbine aerator, easily installed in existing basins as well as in new systems. Get your copy from Industrial Waste Treatment Dept., Pfaudler Permutit Inc., 50 W. 44th St., New York 36, N. Y., or use our card.

Latest Data on Davits for Lighting Standards

77. Is in a just-issued 12-page catalog. In it are classified the various davits available by mounting height, appearance and arm extension. Ask for this booklet by name from Pfaff & Kendall, 84 Foundry St., Newark 5, N. J., or circle our card-number.

New Type Reflective Street Signs

85. Now in production, made of aluminum, a one-piece extruded double-faced sign blade. Either complete to order or blanks for applying your own sign faces. Full details in new circular, from Municipal Street Sign Co., Inc., 128-10 14th Ave., College Point 56, New York, or ring our card-number.

New Booklet on Submersible DeWatering Pumps

86. Gives specifications, performance data and cross-section drawing. Contains application and product pictures on this 3" electric motor driven pump. Yours for the asking of Gorman-Rupp Co., 305 Bowman St., Mansfield, Ohio, or use our card.

Flocculation and Clarification in a Single Water Treatment Tank

87. . . . is the theme of new 4-color illustrated 24-page bulletin SM-1006-R. Describes eight types of Reactor-Clarifier units in terms of specific treatment application, with drawings showing flow patterns. Ask for it by bulletin number of The Eimco Corp., Box 300, Salt Lake City 10, Utah, or check our card-number.

Complete Chemical Feeder Manual

89. 24-pages, illustrated. A fine job, with full discussion of designs, uses and applications for positive displacement chemical solution pumps. Get your copy now from Precision Chemical Pump Corp., 1396 Main St., Waltham 54, Mass., or by circling our card-number.

Study First, Then Dig

92. "Typical Pipe Detection Problems" is the title of this 24-page illustrated booklet that can save you a lot of guessing and blind digging by studying it first. For your copy write Computer-Measurements Co., 12970 Bradley Ave., Sylmar, Calif., or circle our number on card.

Water and Waste Treatment Instrumentation

93. Concise descriptions of all components used for pneumatic instrumentation and control of water and waste treatment operations, including primary measuring devices, transmitters, recording controllers and valve actuating devices are presented in a useful and convenient form in Bulletin 1-15A of The Foxboro Co., Foxboro, Mass. Check the inquiry card.

Readers Service Index

New Catalogs..pages 34, 36 & 38
Sewerage & Waste pages 38 & 40
Construction .....page 42
Lighting & Traffic .....page 43
Business .....page 43
Refuse .....page 44
Snow & Ice .....page 44
Water Works .....pages 46 & 48
Odor Control .....page 48
Streets & Highways pages 52 & 56
Weed Control .....page 56

BEFORE: Laying Troyturf is fast, easy (can be a one-man job). After tamping down Troyturf at one end, workmen roll out the length required. A quick cut, another quick tamping, and the job's done.

Now...grow grass where nothing ever grew before! —use TroyTurf

85° inclines, slopes, flat areas — it's easy to grow rich grass in any soil with Troyturf.

Troyturf is the sturdy pre-seeded mat that contains all the ingredients you need to produce thick, thriving stands anywhere (see diagram). It comes in 90' x 54" rolls that are easy to handle, quick and easy to lay. You simply:

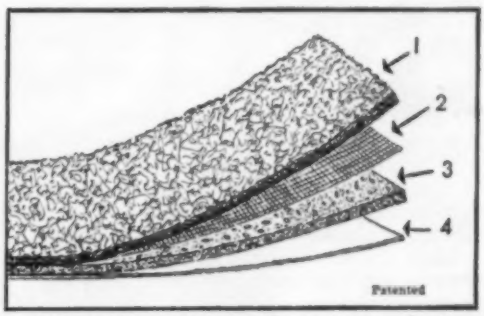
Loosen soil if necessary • Roll out as much as you need
Anchor the edges • Water

That's all Troyturf takes. The rugged mat stays put even on steep slopes, prevents nutrients and seed from being blown or washed away, blocks erosion, inhibits weed growth. Result: thick, grassy stretches where no grass ever grew before.

Think of it — you can beautify ravines, gullies and other eyesores ... lay out rich, new plots or revitalize older ones ... all at a cost far lower than sodding. Can be formulated to meet the soil requirements of your area. Special sizes on request, as well.

Where do you need to grow grass? Do it the easy, money-saving way ... with Troyturf. For informative brochure, write today.

ONE MONTH LATER, you see the result: a vigorous stand 4 to 6 inches high that grew right through the 2 inches of sand washed down on it.



EXPLODED-VIEW DIAGRAM of Troyturf mat, showing: (1) sterilized jute mulch, (2) reinforcing net for erosion control and dimensional stability, (3) certified seed, peat moss and other moisture-retaining materials plus organic and mineral fertilizers and (4) seed germination paper ... all "locked" together in one easy-to-handle mat.

Horticultural Products Division

TROY MILLS, INC.

Founded 1865 • **TROY, NEW HAMPSHIRE**

Address inquiries to: 200 MADISON AVENUE, NEW YORK 16, NEW YORK

To order these helpful booklets check the reply card opposite page 34.

NEW LISTINGS (Cont.)

Controlling Water in Masonry

101. . . . confronts and puzzles practically every building owner, designer or builder. There is still no "wonder drug" cure-all, but a very valuable 44-page booklet is available that goes farther in diagnosis and suggested remedies than anything we have yet seen. Your copy of "Walls Breathe" can be had from Western Waterproofing Co., 1223 Syndicate Trust Bldg., St. Louis 1, Mo.

Use The Reply Card

Valve Design Never Stands Still

106. How it has moved forward in mechanical joint tapping valves and sleeves is the subject of illustrated, specification-filled color folder which is yours on request of The Eddy Valve Co., Waterford, N. Y., or just check our card-number.

Criteria for Proper Highway Sign Lighting

114. Is offered as a guide to best planning and best results. Describes how to calculate required illumination levels, discusses proper mounting of fixtures and gives photometric data for various types of luminaires. Order by name, "Adequate Highway Signing," from General Electric Co., One River Rd., Schenectady 5, N. Y., or check our card-number.

Maintenance Booklet for Unpaved Roads

189. This 36-page pocket-size booklet, so titled, maintains this Institute's pre-eminence in furnishing not only calcium chloride through its members but invaluable data on how to meet common road problems. This book is a "must" for the maintenance man. Ask for your copy, by its name, from Calcium Chloride Institute, 909 Ring Bldg., Washington 6, D. C., or check our card-number.

Exacting AWWA Valve and Hydrant Specifications Met

107. How this is done with Iowa products is given brief, complete illustrated treatment in the new 4-page folder to be had for the asking. Write for Form C-5-27-60 from Iowa Valve Co., Oskaloosa, Iowa, or use our card.

Modern Street and Traffic Sign-Hanging

110. Will be simpler if you have this profusely illustrated folder on how to strap on your street and traffic signs. A little thing that offers big satisfactions. Write for Form SP 2199 2/61 from A. J. Gerrard & Co., 400 E. Touhy Ave., Des Plaines, Ill.

New and More Effective Portable Trencher

133. Described in 4-page, color illustrated folder that makes clear the advantages of new vertical boom that adds versatility. Also new type digging chain design. Order Form 5004 that tells all about it from Century Engineering Co., 1117 Adams St., Waukesha, Wisc.

Automatic Parking Lot Systems

142. Attractive folder clarifies and illustrates the efficiencies and attractions of parking lot control without a burdensome payroll. This may be the solution you have been seeking. Find out by addressing Parcoa Div., Johnson Fare Box Co., 4619 N. Ravenswood, Chicago 40, Ill., or circle number on our card.

Drilling Under May Save Half the Labor Cost

149. This claim of savings is documented by new 6-page folder describing heavy duty machines for putting pipe under pavements, railroad tracks, etc. Ask for Bulletin TD-159 of The Salem Tool Co., Salem, Ohio.

Continuous Treatment Processing Data

154. Here in a 12-page "nut shell" is organized but brief discussion of what this old established company offers you in equipment for agitation, classification, sedimentation, centrifuging, filtration, pumping, fluidization and ion-exchange. Ask for Bulletin 7004 of Dorr-Oliver, Inc., Havemeyer Lane, Stamford, Conn., or use our card.

"How to Lay Out a Parking Lot"

221. If you have that job ahead of you, be sure to get new 40-page Manual with that title. Detailed sketches and photo illustrate angles, stall dimensions, entrances, exits and a host of other questions you will appreciate answers to. Address Western Industries, Inc., Parking Gate Div., 2742 W. 36th Place, Chicago 32, Ill., or circle our card-number.

Technical Data on Plastic Sewer Main Pipe

228. An attractive and most useful booklet that gives the information you will need in considering this modern material for sewers. Goes into engineering details on stresses, crushing resistance and abilities to withstand acids, cleaning and all other common hazards to which working sewers are exposed. Ask for the book from Evanite Plastic Co., Uhrichsville, Ohio.

A Low Cost Chlorinizer

242. Very compact, simple; ideal for sterilization of drinking and swimming pool water and water and sewage or waste treatment plant effluent. Mixes chlorine gas with water and feeds resultant solution. Automatic stop if water supply interrupted. Bulletin Ref. No. 845.201-1 from B-I-F Industries, 345 Harris Ave., Providence, R. I., or use our card.

Five-Year Success Story Polysulfide-Epoxy Concrete Adhesive

244. All data are contained in attractive loose-leaf folder. Covers every use from highways to buildings for concrete repairs. Write for it by name to Hunter-Bristol Div., Thiokol Chemical Corp., 780 N. Clinton Ave., Trenton, N. J., or check our card.

Permanent-Type Reflective Pavement Markers

256. . . . and all of their advantages in traffic marking are fully described and illustrated in the 12-page brochure giving all needed information in attractive form on Plastix markers. Ask for Catalog PX-60 from Prismo Safety Corp., Huntingdon, Pa.

"Flexible" CAM DRIVE UNIRODER

An entirely new principle providing Non-Slip Rod Drive!

NO ROLLERS TO SCORE OR BURN

ANOTHER "Flexible" FIRST!

UniRodeR Model SUR-1 rods sewers and is ideal for threading cable for bucket machines

CAMS GRIP TIGHTER UNDER LOAD

Revolutionary! Traveling cams push or pull the continuous rod, rotating with it in either direction. The heavier the load the tighter the cams grip the rod. NO FRICTION ROLLERS TO SCORE OR BURN. Exclusive Safety Overload Clutch protects pipe, machine and rod. Simplified mechanism and fewer working parts mean less maintenance than any other continuous rodder!

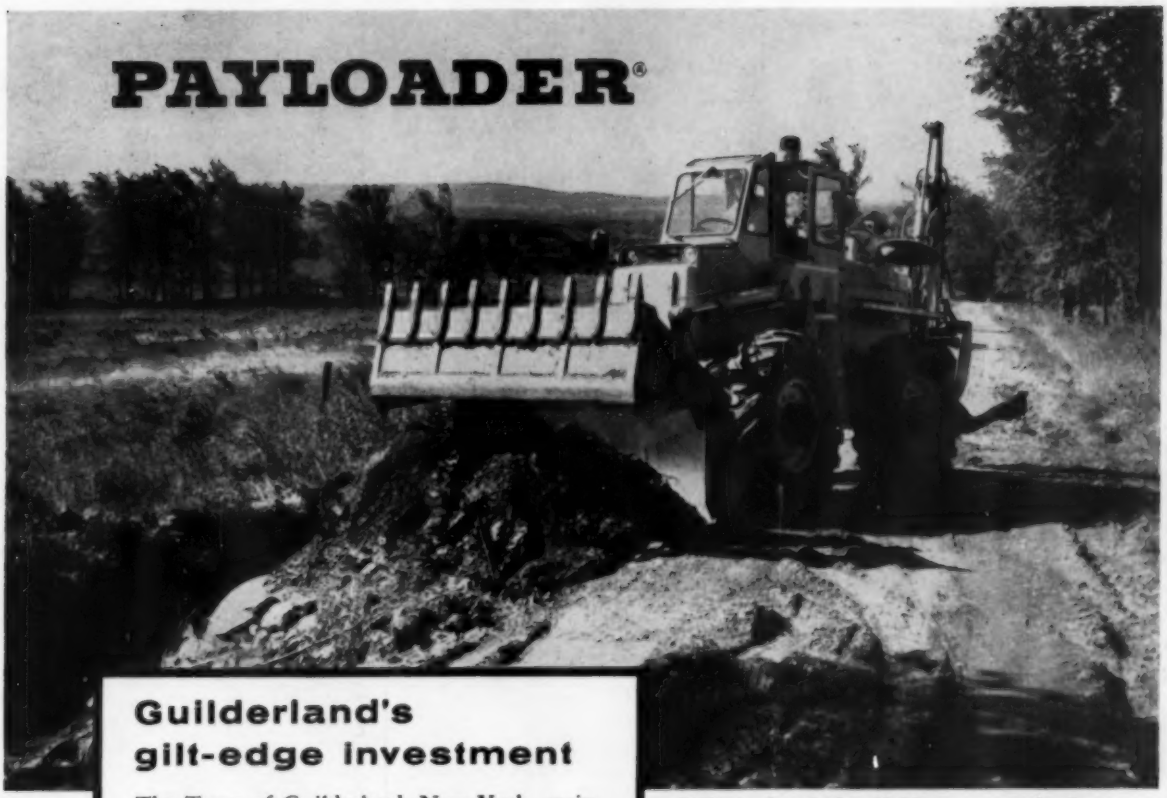
- 8 Speeds Forward or Reverse
- Positive Non-Slip Cam Drive
- Capacity up to 2000 ft.
- Tool Box, 3 cu. ft. Capacity
- All Moving Parts Enclosed
- Safety Overload Clutch
- Footage Meter
- Uses From ¼ to ⅝-in. Rod
- 9 hp. with Self Starter

FLEXIBLE INC.

415 S. Zangs Blvd., Dallas, Texas

Factories: Los Angeles, Calif. and Lima, Ohio

PAYLOADER®



Guilderland's gilt-edge investment

The Town of Guilderland, New York, maintains 115 miles of its own roads — 60 paved and 55 unpaved. One of its most useful, versatile and busy machines is a Model H-50 PAYLOADER equipped with a Drott "4-in-1" bucket and a Wain Roy hydraulic backhoe. It is used for sewer work as well as for road construction and maintenance.

Victor Bassler, Superintendent of the Highway Department says, "We've only had this rig about a year but it has really done a job. In fact it has done all kinds of jobs, and its versatility continues to surprise us as we find more things it *can* do. Sloping banks and loading out awkward materials like brush, stumps and boulders are examples of many troublesome and time-consuming jobs that it does quickly and cheaply. It has also been a valuable and busy machine this past winter as a snow fighter. Here is a rig with which we can tackle just about any job that comes along."

Your Hough Distributor is ready to show you how a PAYLOADER can be a gilt-edge investment for you, too. See him today.

HOUGH®

THE FRANK G. HOUGH CO.
LIBERTYVILLE, ILLINOIS
SUBSIDIARY — INTERNATIONAL HARVESTER COMPANY

HOUGH, PAYLOADER, PAYMOVER, PAYLOGGER, PAYLOMATIC and PAY are registered trademark names of The Frank G. Hough Co.

Both ends of the H-50 were used plenty to clean up after hurricane "Donna" — the backhoe to clean out and reshape ditches, the "4-in-1" bucket to remove fallen trees, fill in washouts and clean up debris.

THE FRANK G. HOUGH CO.
761 Sunnyside Ave., Libertyville, Ill.

Send me "More mileage for your tax dollar"

Name _____

Title _____

Dept. _____

Street _____

City _____ State _____

5-B-6

To order these helpful booklets check the reply card opposite page 34.

NEW LISTINGS (Cont.)

Sewage Lift Stations and Submersible Pumps

173. Specialized equipment for water and sewer service. Beautifully illustrated brochure gives you all you need to know, including specifications and dimensions. Get your copy from Davco Corp., Thomasville, Ga., or ring number on our card.

Keep Ahead of Your Traffic

187. With latest illustrated data on equipment for controlling it. Describes many special features of interest and value to you in your work. 24 pages. Write for Bulletin A20 to Eagle Signal Co., Moline, Ill.

Valves for Concrete Pipe

208. And no adapters needed. That is the title and the message of this new illustrated brochure in color covering this specific problem in using this type of pipe. Double disc valves with O-Ring Joints are fully discussed. Get Circular No. 26 from M & H Valve & Fittings Co., Anniston, Ala., or use our reply card.

New Incinerator Grate

250. The new Nichols Fuller reciprocating grate for continuous feed of refuse and continuous discharge of residue by automatic and completely mechanical means is described in new Bulletin offered by Nichols Engineering and Research Corp., 80 Pine St., New York 5, N. Y., or check its number on our card.

Photoelectric Lighting Control

252. How this "Lamplighter" works and why it works so well is covered in the six-page brochure offered free by The Acme Wire Co., Utility Products Div., New Haven 14, Conn.

Which is Cheaper—Low Initial Price or Low Final Cost?

257. How this applies to a crane-excavator is covered by newly-available literature that gets to the bottom of this important question. Without obligation, write for your copy to Unit Crane & Shovel Corp., 6654 W. Burnham St., Milwaukee 19, Wisc.

How to Qualify for Free "Welcome" Signs to Your Town

260. They go with your Alcoa Aluminum Street and Stop Signs. By all means get the details on this attractive "package" deal that combines good public relations with better traffic signs. Just write Aluminum Co. of America, 897-D Alcoa Bldg., Pittsburgh 19, Pa., or use our reply card.

For Mixing and Pulverizing at Low Cost

263. This is the answer to the contractor, city or county that is faced with a $10,000 investment or more in a single-purpose soil Blender. Works on modern tractor power in the 55-80 hp. class. Full details are in a 4-page illustrated informative folder. Ask for Form 263 from Howard Rotavator Co., Harvard, Ill., or just check our card-number.

A Tape Measure on Wheels

272. You walk with it and it clocks off feet and inches like an automobile speedometer. Circular describing its many public works uses and full details available on request from B. G. Reilly Co., Box 231, North Scituate, R. I. or by using our reply card.

Just Vacuum Clean Your Catch Basins, Streets and Highways

285. New cleaner designed to pick up and haul heavy street and highway debris, even bottles, cans, etc. as well as leaves. Unique features for by-passing the blower permits direct entry of heavy debris into the body. All details are in Bulletin V-2 from Central Engineering Co., Inc., 4429 West State St., Milwaukee 8, Wisc., or use our reply card.

Road Rollers, Scrapers, Distributors or Street Flushers . .

287. Whatever your need from fill to finish, there's a Seaman product to help you build better roads at lower cost. Before you do anything in this line or on soil stabilization write for specification sheets, to Seaman-Gunnison Div., Seaman Corp., P. O. Box 3025, Milwaukee 18, Wisc., or check our card-number.

SEWERAGE AND WASTE TREATMENT

What You Should Know About Trickling Filter Underdrains

20. Specifications for vitrified clay under drain blocks conforming to ASTM standards, suggestions for layouts and construction of trickling filter floors, dimensions of standard blocks, channel covers, angles and other fittings are available from the Trickling Filter Floor Institute c/o Editor, Public Works, 208 So. Broad St., Ridgewood, N. J. Check the reply card and we will forward your request.

How to Make Better Sewer Pipe Joints

37. How to make a better sewer pipe joint of cement—tight, minimizing root intrusion, better alignment of joint. Permits making joints in water-bearing trenches. General instructions issued by L. A. Weston Co., Dept. P.W., Adams, Mass. Check the reply card.

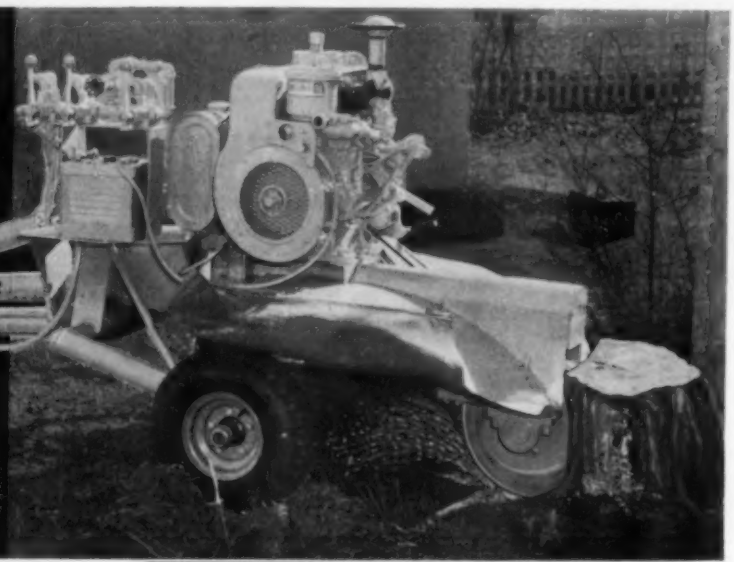
Catalog on Synchronous Motors and Controls

64. A 27-page Catalog B-7292 on synchronous motors and controls is well illustrated and contains motor selector charts, application data, and formulas for calculating power factor. For a copy write Westinghouse Electric Corp., Box 2099, Pittsburgh 30, Pa., or check the reply card.

Theory of Controlled Digestion With Floating Cover Tanks

88. In an excellent 40-page booklet, an authoritative discussion of digestion theory and practices, including design, operation and economics is presented by the Pacific Flush Tank Co., Chicago 13, Ill. Complete data are given on the use of floating covers, together with details on tank construction, piping and control chambers.

LOOKING FOR LOW COST
STUMP REMOVAL?



New Model 6
VERMEER POW-R STUMP CUTTER

Rips Stumps To Shreds in Minutes!

Here's a small, powerful, low cost Pow-R-Stump Cutter that's designed specifically for those hard-to-get-at places . . . back yards . . . cemeteries . . . thru gates . . . next to buildings, fences, shrubbery, etc. Removes largest stumps to a depth of 6" below the ground. Highly maneuverable, the Model 6 is only 36" wide in transport position. Safe and simple to operate. Ask for demonstration.

MAIL COUPON FOR ALL THE FACTS

Please send information, literature and price on your Model 6 Vermeer Pow-R-Stump Cutter.

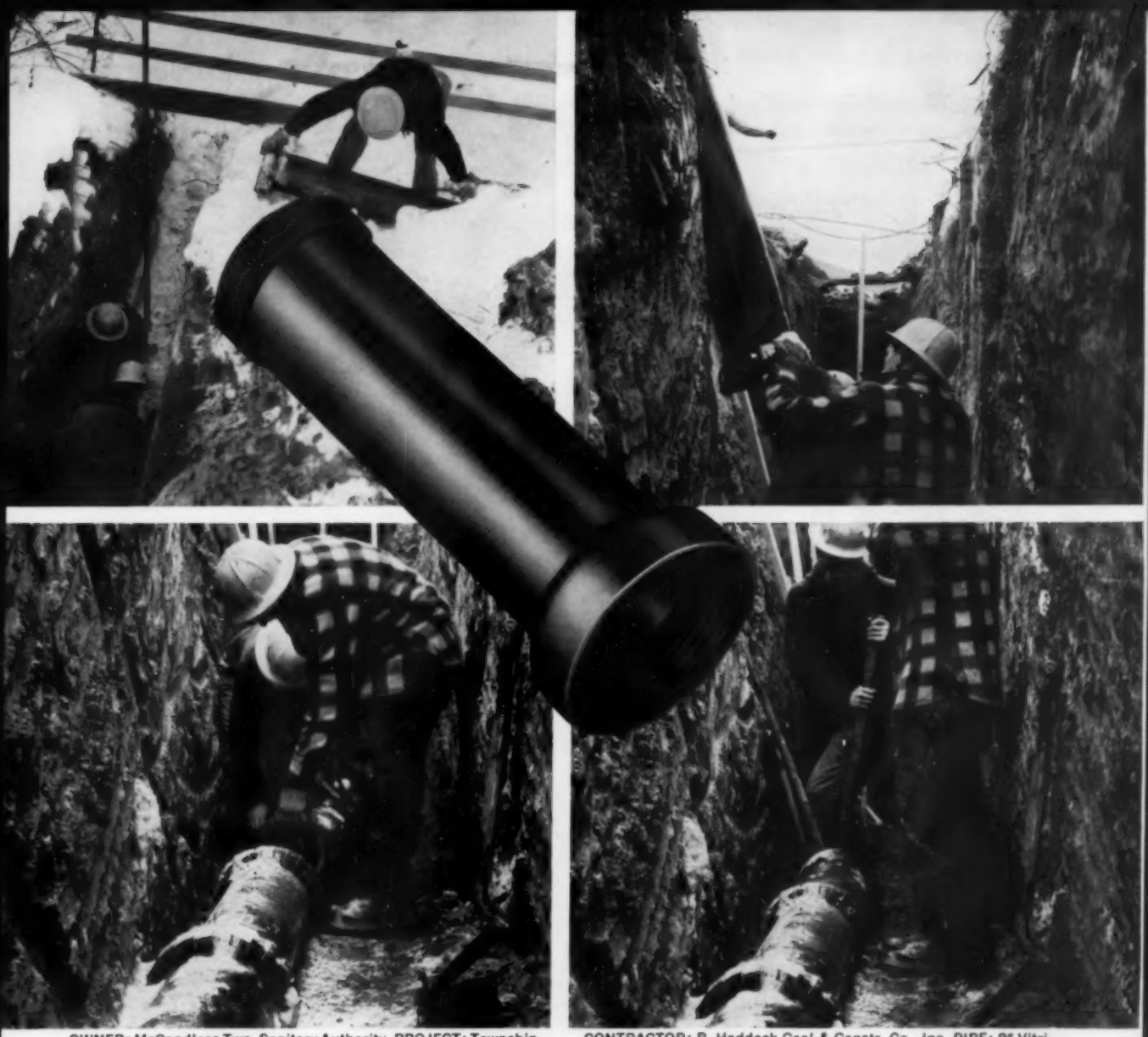
Name.....

Firm or Dept.....

Address.....

City..... State.....

VERMEER MANUFACTURING CO.
1439 W. WASHINGTON • PELLA, IOWA



OWNER: McCandless Twp. Sanitary Authority. PROJECT: Township Sewage System, Allegheny County, Pa. ENGINEER: Wm. J. Murdock.

CONTRACTOR: P. Haddock Coal & Constr. Co., Inc. PIPE: 8" Vitrified Clay Pipe with Uniloc Coupling.

For leakproof joints that "go home" fast . . . nothing beats U. S. Uniloc Flexible Couplings!

United States Vitrified Clay Pipe with Uniloc Flexible Couplings provide you with a fully integrated pipe unit having maximum flexibility, alignment, durability and tightness properties.

U. S. Pipe with Uniloc is easier to install. It seats in only seconds, saves time and money.

Made of durable polyvinyl plastisol, Uniloc Couplings multiple rings seal watertight automatically. The joint is tough, abrasive resistant and unaffected by raw sewage and most industrial acids. A true compression joint, Uniloc provides ample flex for pipe angularity, soil stress and over burdens.

To provide better waste handling at lower cost, specify U. S. Vitrified Clay Pipe with Uniloc Couplings. Get complete information by dropping us a note on your letterhead.

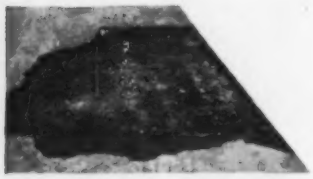
UNITED STATES CONCRETE PIPE CO.

A SUBSIDIARY OF PITTSBURGH COKE & CHEMICAL COMPANY

1500 Union Commerce Building · Cleveland 14, Ohio · Telephone MAin 1-5240

Sales Offices: Baltimore · Pittsburgh · Philadelphia · Cincinnati · Ft. Lauderdale · Ocala · Kalamazoo 3007

FOR YEAR 'ROUND LOW-COST PAVING AND PATCHING, USE A *McConnaughay* MIXER



THE MOST COMPLETE LINE OF ASPHALT PATCHING MIXERS . . .

Write today for your copy of "McConnaughay Presents the Most Complete Line of Asphalt Patching Mixers". This folder describes the complete line of mixers for patching or repairing on a wide variety of paved surfaces and for resurfacing or sealing streets, highways, joints and cracks, driveways, parking areas, sidewalks, and floors. From patching by the foot to paving by the mile a McConnaughay HTD Mixer will do the job.

HTD MIXER No. 10	**HTD MIXER No. 5**
½ ton per batch	¼ ton per batch
HTD MIXER No. 8	**HTD MIXER No. 4-T**
⅓ ton per batch	⅓ ton per batch

McCONNAUGHAY MIXERS, INC.
LAFAYETTE, INDIANA
National distributors: Asphalt Equipment Co.
3314 Cherry Lane, Fort Wayne, Indiana
Export Representative: William H. Schuelie, 440 E. 79th St., New York 21, N. Y.

To order these booklets check card opposite page 34.

Rated Aeration Now Can Be Had in a Package

112. Chicago Pump's aerobic digestion sewage treatment plant is available as a factory assembled unit combining comminution, diffused-air aeration and settling for 1,000, 3,000, and 5,000 gpd loads. Write for bulletin on Rated Aeration SS, Chicago Pump, Food Machinery and Chemical Corp., 622 Diversey Parkway, Chicago 14, Ill., or check the reply card.

Elliptical Concrete Pipe for Sewers and Culverts

143. A 4-page bulletin is available from United States Concrete Pipe Co., 1500 Union Commerce Bldg., Cleveland 14, Ohio, on the use of elliptical pipe to obtain round pipe flow equivalents in certain areas. Check the reply card for diagrams, data charts and tables that fully describe elliptical pipe sizes and compute discharge flow rates for the full range of pipe sizes.

Guide Book Information for Emergency Power

153. This book covers what to do when commercial power fails in a fire, flood, hurricane, war and other national disasters. Check the reply card or write Caterpillar Tractor Co., Engine Div., Peoria, Ill., for a copy of "The Four Horsemen of the Space Age."

Transite Pipe

166. Johns-Manville "Transite" Sewer Pipe, made of asbestos-cement, is available in 11 different diameters ranging from 6" to 36" and in five new crushing strengths to permit greater efficiency in system design. "Ring-Tite" Coupling, designed for high-speed assembly, provides tight, long-lasting seal. Easy-to-assemble Transite sewer fittings also furnished. For complete information, write for brochure TR-165A (Transite Sewer Pipe), TR-94A (Sewer Design Flow Chart), and DS-366 (Transite Material Specification). Johns-Manville, 22 East 40th St., New York 16, N.Y. Check reply card.

A Short Course In Pipe Jointing

169. The story of rubber couplings for clay and concrete pipelines is graphically presented in the booklet "Pipe Enterprise", published by Hamilton Kent Mfg. Co., Kent, Ohio. Detailed description of pipe jointing methods; photos showing jobs where Tylox gaskets met the need for easily assembled permanently tight joints installed under all conditions; and a report on the development, manufacture and outstanding features of the compression type gasket make this booklet valuable to every engineer and contractor. Check the reply card.

Data Book For Engineers

199. New Link-Belt Catalog (No. 2617) includes all recent additions to their Water, Sewage and Industrial Waste treatment equipment. All designing engineers will want this one. Write Link-Belt Co., Colmar, Pa., or use the card.

Manual on Filter Bed Agitators

206. General information-specifications and installation data regarding the application of Palmer agitators, or rotary surface wash in vertical and horizontal pressure filters—round, square and rectangular open gravity type filters are covered in Manual from Palmer Filter Equipment Co., 822 East 8th St., P. O. Box 1696, Erie, Penna. Check the reply card.

How to Save $264 per Mile

216. . . . in sewer cleaning is the gist of a new 8-page brochure that discusses just how such savings can be accomplished. It costs nothing to find out and it may be your best investment of the day. Write for it to Flexible, Inc., 415 South Zangs Blvd., Dallas 8, Texas, or circle the card number herewith.

Packaged Pump Stations for Sewage

306. . . . of advanced design and with six advantages not "packaged" for you elsewhere, are covered in this informative Bulletin No. PS-60R to be had by writing Tex-Vit Mfg. Co., Box 117, Mineral Wells, Texas.

Manual on Sewer Structures

178. This is a 48-page manual on installation design, reference data and graphs showing discharge of pipe based on Manning's formulas. Also such subjects as structural durability, material durability; selection of structures; factors influencing capacity; joints and fittings; and linings for failing sewers are covered. Copies of Manual CMS-7456 are available from the Product Information Service, Armco Drainage & Metal Products, Inc., Middletown, Ohio, or by checking the reply card.

How to Dispose of Sewage and Industrial Sludges

281. Get full information on the C. E. Raymond System of combined incineration and sludge drying providing high temperature deodorizing for nuisance-free sludge disposal. Flexible layouts fit large and small communities. Use handy reply card or write Combustion Engineering Inc., Raymond Div., 427 West Randolph St., Chicago 6, Illinois.

When It Comes to Pumps

311. You will profit by having this 4-page condensed bulletin which illustrates and describes the Aurora Centrifugal and Axco Turbine Type Pumps with capacity ranges from 1 to 9000 GPM, and heads to 600 ft. Just write for your copy to Aurora Pump Div., The New York Air Brake Co., 630 Loucks St., Aurora, Ill., or circle number on card herewith.

Trenches for Water and Sewer Line Construction

384. Three Cleveland J trenchers incorporating major advances in trencher design and operating advantages are described in Bulletin L-104 available from The Cleveland Trencher Co., 20100 St. Clair Ave., Cleveland 17, Ohio. Check the reply card for digging capacities, specifications and dimensions.

Use The Reply Card

Wedge-Lock "O" Ring Joints for Vitrified Clay Pipe

482. Joints for large diameter pipe, using the Wedge-Lock principle of factory made joints plus a rubber "O" ring for compression sealing, described in 4-page folder of Evans Pipe Co., Uhrichsville, Ohio. Check reply card for your copy.

27 Diesel and Carbureted Engines Detailed in one Booklet

527. Describes and illustrates all types, from 16.4 to 385 hp., in weights 279 to 6,045 pounds. A brief, handy way to review available industrial engines. To get your copy, write for pamphlet CR-764-K to International Harvester Co., 180 N. Michigan Ave., Chicago 1, Ill. or circle the number on our card.

Reinforced Plastic Pipe and Fittings

549. . . . . for water and sewage service, in sizes 2 through 8 inches, made of epoxy resins and glass highly resistant to hydrogen sulfide gas, electrolysis and difficult soil conditions. Booklet tells all in 16 illustrated pages. For your copy write Amercoat Corporation, 4809 Firestone Blvd., South Gate, Calif., or circle number on the card.

Transite Pressure Pipe and Couplings

612. . . . are fully described in new 8-page brochure enumerating the advantages of this type of pipe. Special emphasis is placed on exclusive methods of assembly. Also includes complete up-to-date material specifications for J-M Transite Pressure Pipe. Ask for booklet TR-160A from Johns-Manville, 22 E. 40th St., New York 16, N. Y., or use our card.

Factory-built Sewage Treatment Plants to Serve Smaller Users

673. Complete factory-built Oxigest sewage treatment plants for small subdivisions, schools, motels and factories are described in detail in an illustrated brochure furnished by Smith & Loveless, Div. of Union Tank Car Co., Lenexa, Kansas.

New UNIT 1-YD. MACHINE

FAST, POWERFUL, BUILT-TO-LAST *for lowest cost yardage*

Here is the **new** MODEL 271-C, Unit's answer to your need for a 1-yd. machine that will do a better job of moving dirt, **yet be economical to own and maintain.** This new addition to the UNIT line retains many of the time-proved features that have won other UNITS world-wide fame for complete reliability and top performance. Add to these dependable features new advances exclusive to the UNIT 271-C, and you'll see why this machine can make more money for you.

The UNIT 271-C features a **new** compact swing circle gear assembly with upper works mounted on a large diameter, double live ring of steel balls running in hardened races. On the job, this means a friction-free, fast swing. With center pin mounting, hook and turntable rollers, and roller path eliminated, there's little lubrication required . . . practically no day-to-day maintenance.

The **new** 271-C also features a unique system that keeps hard working swingers extra cool, extending their life. Swingers run in a bath of oil which is kept cool by a set of copper coils connected directly to the radiator cooling system. Thermostatic control holds temperature below the point where clutch lining life is normally affected by heat.

There is a lot more to tell about these and other UNIT advantages on this, the newest entry into the 1-yd. field. Let your local Unit distributor give you the complete 271-C story.

UNIT

UNIT CRANE & SHOVEL CORP.
6654 W. Burnham Street
Milwaukee 19, Wisconsin

The Model 271-C

FEATURING

DOUBLE BALL BEARING SWING CIRCLE
Friction-free swing, higher load capacity, sharply reduced maintenance time.

OIL-COOLED SWING CLUTCHES
Here's the ultimate in dissipation of harmful heat!

EXCLUSIVE ONE-PIECE MAIN MACHINERY CASE
All gears, shafts, and bearings completely enclosed in a constant oil bath.

EXCLUSIVE AUTOMATIC TRACTION BRAKES
Trigger-fast braking provided in either direction of travel **without manual control.**

STRAIGHT-IN-LINE ENGINE MOUNTING
Longer life, better performance, and increased efficiency because all working parts are perfectly aligned . . . power flows directly to main machinery.

NEW FULL VISION CAB
Operator can see in ALL directions at all times. Promotes safety, increases efficiency.

DISC-TYPE CLUTCHES
Provide uniform pressure without grabbing or chattering . . . easily adjusted.

WORM-DRIVEN POWER TAKE-OFF
Provides "one step" speed reduction between power unit and transmission shaft . . . eliminates many wearing parts . . . minimizes friction losses.

FULL CONVERTIBILITY
Shovel, dragline, trenchoe, clamshell, liftcrane, and magnet crane front ends available.

INVOLUTE-SPLINED SHAFTS
Shafts in upper works and crawlers are involute-splined for greatest strength. Wear is reduced . . . replacement is seldom necessary.

To order these helpful booklets check the reply card opposite page 34.

CONSTRUCTION EQUIPMENT AND MATERIALS

Fallacies of the "Low Bid"

78. . . . were never better exposed than in this thoughtful new booklet titled "The Best Bid for Your Budget." Reveals the hidden factors that often make the "low bid" the high bid in purchasing motor graders. For your copy of Form E014, write Caterpillar Tractor Co., Peoria, Ill., or check the inquiry card.

International Wagner Heavy-Duty Loaders and Backhoes

195. International Wagner loaders and backhoes are matched with International utility tractors and are described in Catalog CR-1369-K available from International Harvester Co., Consumer Relations Dept., 180 N. Michigan Ave., Chicago 1, Ill. Check the reply card.

Booklet Shows Design of Pre-Engineered Steel Buildings

271. Pre-engineered Butler steel buildings are available in every size, type and design to meet your building needs. In a helpful four color booklet you will find details on several basic designs for community use; answers to your questions on construction and erection; and many illustrations of typical uses. Write to Butler Mfg. Co. 7321 East 13th St., Kansas City, Mo.

The Principles of Compaction by Vibration

288. Compaction specifications that can't be met with ordinary compactors are no problem to the new Essick vibrating rollers. Complete descriptive literature explaining the principles of compaction by vibration and the Essick vibrating roller is available from Essick Mfg. Co., 1950 Santa Fe Ave., Los Angeles, Calif.

One Unit; Four Different Machines

392. Operators of the International Drott 4-in-1 Skid Shovel have four different machines at their fingertips, ready for use as a bull-dozer, scraper, skid-shovel and clamshell. To review these varied services and many exclusive features get Bulletin CR-600-I. International Harvester Co., 180 N. Michigan Avenue, Chicago 1, Illinois.

For Better Work All Over Town

525. Put a Bantam in your life. On trenching, excavating, street and highway work this handy versatile crane-excavator obviates using larger equipment in many cases. Saves time and dollars. Get descriptive literature from Schield Bantam Co., 301 Park St., Waverly, Iowa or circle card-number.

For Easy Reference on Contractors' Pumps

598. . . . get the McGowan bulletin on a complete line suited to all municipal needs. Self-priming models in 1-in. to 8-in. size, light weight and heavy duty, centrifugal and diaphragm types. Write McGowan Pump Division, Leyman Mfg. Corp., 10900 Kenwood Road, Cincinnati 42, Ohio.

The Tractors that Put the Utility into Utility Tractors

618. Low profile, high clearance, and a new Shuttle clutch, power steering are a few features. For the full story write Allis-Chalmers Mfg. Co., Milwaukee 1, Wis., for Utility Tractors literature, or circle our card-number.

Attachments For Ford Tractors

643. Clearing, backfilling, ditching, excavating, mowing, scarifying, sweeping, and trenching equipment are a few of the attachments described in literature from Tractor and Implement Div., Ford Motor Co., 2500 East Maple Road, Birmingham, Mich.

What Henry Didn't Know About Tractors and What It Cost Him

513. This is the theme of a "comic book" that has as much sound information and sense in it as it has laughs. And there are plenty of both. Moral: Ignorance is not bliss when it is costing the tractor owner money. Your men will appreciate it. For copies, write for "Henry's Crawler," to Advertising Dept., J. I. Case Co., Racine, Wis. or circle our reply card.

Color Catalog Describes "Michigan" Tractor Dozers

631. A 20-page catalog on "Michigan" Models 180, 280 and 380 tractor dozers covers the design and operating features and explains how the hydrulic controls regulate all dozer operations. For your copy write to Construction Machinery Div., Clark Equipment Co., P. O. Box 599, Benton Harbor, Mich., or check the reply card.

Use The Reply Card

Planning for Concrete Placing

564. . . . . with latest knowledge of equipment available for this work. Three circulars available describe a pneumatic pressure grouter; a Hydra-Jak which is a combination of a mud-jack and sand and cement Grouter; and a Uni-Cretor for gunning and pumping various mixes. For yours write Air Placement Equipment Co., 1000 W. 25th St., Kansas City 8, Mo., or ring our number on card.

Versatile Crawler With Power and Controlability

707. Within this 24 page booklet (Form No. 607R) are liberally illustrated descriptions of the features of the Euclid C-6 for clearing, dozing, stripping, grading and a variety of other applications. Specifications covered. Circle reply card or write to Euclid Division of General Motors Corporation, Cleveland 17, Ohio.

SPEED SENSITIVE SWITCHES

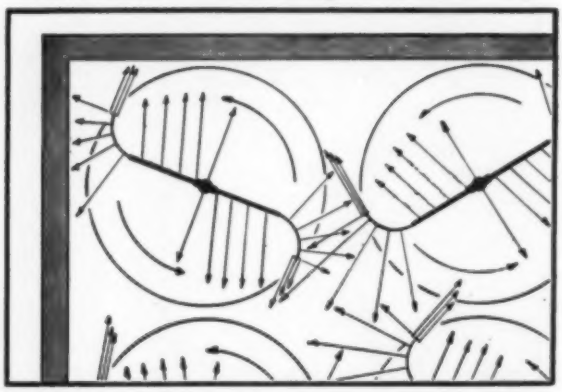
All GH series of cable driven governors and switches are available in this GH-E series. This housing meets the specifications for class 1 group D, Explosion Proof Equipment. For further information, write for Bulletin 504-A.

SYNCHRO-START PRODUCTS, INC.

8151 N. RIDGEWAY AVE. SKOKIE, ILLINOIS

NOW! A 25% to 30% further increase

in filter cleaning efficiency



New S-Type Filter Arms double the cleaning action

With new S-Type arm of Agitator shown above each corner and void area receives four (4) agitating impulses per revolution instead of two . . . doubling the cleaning action in those areas. S-Type Arms can also be adapted to older units in service. Ask us for full particulars.

(Patent Pending)

Palmer Filter Equipment Co. 822 E. 8th St. Erie, Penn.

To order these booklets check card opposite page 34.

STREET LIGHTING AND TRAFFIC CONTROL

Steel and Aluminum Lighting Poles for Streets and Highways

74. Standard designs, assembly details, suggested pole sizes and base construction details are some of the information offered in Bulletin LS-29 (Steel) and Bulletin LS-30 (Aluminum). Check the reply card or write The Union Metal Mfg. Co., 1432 Maple Ave., NE., Canton 5, Ohio, for details covering the latest Monotube pole designs for modern streets and highways.

Finest Line of Markers for Fine Line Marking

165. Complete information on truck mounted highway markers, self-propelled line markers, all purpose line markers, and hand-propelled line markers is available from the M-B Corporation, New Holstein, Wis. Photographs and specifications of each type of line marker are included. For more, check the handy reply card.

Literature on Reflective Glass Beads

571. Glass beads for traffic signs and street name signs as well as sign bead dispenser equipment, are described in literature available from Flex-O-Lite Mfg. Corp., 8301 Flex-O-Lite Drive, P. O. Box 3066 (Affton Br.) St. Louis 23, Mo. No. 831 high index of refraction glass beads for white and yellow backgrounds and UB 68 medium index of refraction glass beads for reflectorizing dark colors such as red, green, blue, etc.

Let Progress Hit Your Highway Signs, too

575. An overlaid plywood especially engineered for highway sign construction is now available in natural surface for reflective overlays, also in green, white, red and blue. AASHO approved. Resistance to damage cuts maintenance costs. For GPX description and specifications write Georgia-Pacific Corporation, Equitable Bldg., Portland 4, Oregon, or circle number on our card.

BUSINESS ADMINISTRATION

If You are Considering a trustee for a Bond Issue Check with Chase Manhattan

236. For details on how a bank serves as trustee for bond issues for any municipal or governmental unit, write The Chase Manhattan Bank, 40 Wall St., New York 15, N. Y.

Monthly Time and Cost Record Book

249. To assist owners in determining the cost of owning and operating equipment Caterpillar Tractor Co., News Service, Peoria, Ill., has prepared a 24-page monthly time and cost record book. Twelve sets of pages are included on which to record day by day machine expenses for an entire year. Check the reply card for your copy.

Complete Bulletin On Municipal Supplies

473. Everything from leak locators to street signs is listed in the big 100 page bulletin "Municipal Supplies" published by Darley. Hundreds of different items for all city departments are included. Get your copy of Bulletin No. 163 from W. S. Darley & Co., 2814 Washington Blvd., Chicago 12, Ill.

AIRPLACO
ADVANCED DESIGN EQUIPMENT SAVES DOLLARS ON CONCRETE WORK
SAVE on bridge repair
SAVE on sidewalk and curb repair

SAVE ON ALL CONCRETE CONSTRUCTION AND RESTORATION WITH AIRPLACO

You save cold, hard cash when you use AIRPLACO "Advanced Design" concrete gunning and placing equipment. You save valuable time—speed up work. Save on labor—fewer men get more work done. Save on materials—get higher efficiency, more versatility. Investigate AIRPLACO for your next concrete job.

COMPLETE LINE

AIRPLACO offers you a complete line of concrete guns, portable mixers, grouters, placers, sandblasters and a complete line of accessories.

FREE CATALOG

AT YOUR SERVICE — Draw upon the experience of the world's leading manufacturer of pneumatic concrete placing equipment. Let us help you solve your concrete maintenance and restoration problems. Write, wire or phone, anytime.

AIRPLACO AIR PLACEMENT EQUIPMENT CO.

1013 WEST 25TH ST. • KANSAS CITY 8, MO.

WORLD'S LEADING MANUFACTURER OF "ADVANCED DESIGN" PNEUMATIC PLACING EQUIPMENT

Order these booklets by checking reply card.

CLEAN PAVEMENTS

with Low Cost Vacuum the "City Slicker" Way

The Tarco "City Slicker" cleans pavement **FAST** with air power and vacuum. It's **most economical.** The operating cost of a "City Slicker" is **only about ¼ of the curb mile cost of most other cleaning methods.** For every curb mile you use a "City Slicker" you will **cut your cost up to 75%.**

The "City Slicker" cleans a wide path by means of air power and vacuum . . . no brooms or brushes to wear out or service. It **sucks up** and **separates** for quick handling: (1) all kinds of **light bulky litter:** newspapers, paper cups and wrappings, cigarette butts, etc., (2) dry **sand;** (3) light fine **dust.**

With maximum operator visibility the "City Slicker" is **Safe** and **maneuverable** in heaviest traffic. Dusty air is cleaned in special cleaners . . . no filter elements to clean or service and no need for water sprinkling. Using a "City Slicker" **releases large power sweeping equipment** for more important dirt sweeping work for which they are dseigned.

"City Slickers" are **now performing** money-saving litter collection work **in several large cities.** For details see your TARCO dealer or write to us.

TARRANT MFG. CO.

28 Jumel Place, Saratoga Springs, N. Y.

ACKER DOUBLE-DUTY RIG

FOR AUGER BORING OR CORE DRILLING!

Acker SP handles 5 foot hollow-stem or conventional auger flights. Switches to roller rock, carbide, saw tooth or diamond bit coring. The SP handles angle or vertical holes, deep or shallow in any formation.

Core drilling or augering problems anyone? Just name it—the Acker SP will tame it! It's rugged and versatile . . . switches from core boring to augering. It has muscle to auger 300 feet or core to 1500!

Acker's SP is designed for heavy duty service. It has a four speed cathead hoist, built-in reverse and four speed transmission. It's completely self-contained and mounts on truck. Owners of the SP are reporting unprecedented results drilling and augering for soil samples, in hollow stem augering and geophysical and geological exploration.

For more information write for Bulletin 31-ST or have us demonstrate the versatility of this advanced rig. There's no obligation!

ACKER DRILL CO., INC.

P. O. BOX 830 • SCRANTON 2, PA.

REFUSE COLLECTION AND DISPOSAL

Where Does It Go From Here?

63. That is the title of new 12-page booklet, D 930, with thorough discussion of garbage disposal by sanitary landfill method. Read the latest report from the experts. Caterpillar Tractor Co., Peoria, Ill., or check card.

Reduce Your Refuse Disposal Costs

150. A complete line of refuse disposal systems that include containers, giant containers, compaction bodies and compaction trailers are described in literature from Dempster Brothers, Dept. PW, Knoxville 17, Tenn. Check the reply card for data on these efficient systems

Bulk Refuse Collection with or without Containers

192. A bulletin describing the bulk refuse system called the Roto-Pak Container System, which provides an unusual flexibility of service and the handling of all types of trash, is available from City Tank Corp., Culpeper, Virginia Check the reply card.

Select Your Incinerator Scientifically

275. Here is a new swift simple way of selecting the correct industrial, institutional or business-use incinerators for various types of installations. The device is somewhat like a slide rule and takes in the variable factors which determine choices in incinerators. Get yours from Morse Boulger Inc., 80 Fifth Ave., New York 11, N. Y., or check number on our card.

Prompt Service on Sweeper Refill Fibers

367. Here's a dependable source of power sweeper refill fibers, including domestic and imported types and gutter broom wire. To get all the data write A. Steiert & Son, Inc., Hatfield, Pa., or use our reply card.

Methods and Benefits of Sanitary Landfill

409. Information on Sanitary landfill methods, organization and necessary equipment with which to carry out the job is available from the Construction Machinery Div., Allis-Chalmers Mfg. Co., Milwaukee, Wis. Bulletin MS-1159.

An Incinerator that Small Cities Can Afford

541. Informative folder shows how smaller cities and major institutions and industries alike are getting low costs and high efficiency with simple low cost Wilco Tepee Refuse Burners. Dimensions, specifications and descriptions included. For your copy address Wilco Machine Works, Inc., Box 3722, Memphis 14, Tenn.

Modern Methods in Sanitary Landfills

699. Up-to-date data, pictures and explanation of sanitary landfill, its methods and equipment are covered in this valuable bulletin from The Oliver Corp., 19300 Euclid Ave., Cleveland 17, O. Check the reply card for information on satisfactory garbage and refuse disposal methods.

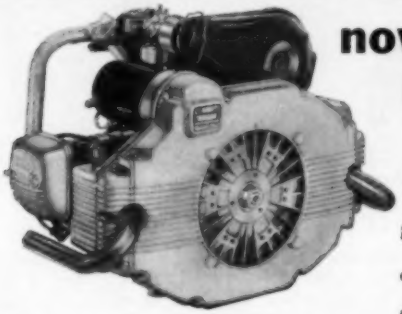
SNOW AND ICE CONTROL

Complete Ice and Snow Fighting Equipment

523. Snow plows in 55 models and 9 types, material spreaders with width of spread of 8 to 20 ft. and hopper capacity of 2 cu. ft., and truck grader ice blades are covered in literature from Wausau Iron Works, Wausau, Wisc.

nearest thing
yet to
COST-
FREE
transportation

CUSHMAN TRUCKSTERS®



now with new, more powerful, die-cast aluminum engines!

Cost-cutting Trucksters now deliver more live power, more efficiency, more versatility and utility with either of Cushman's great new, advanced, die-cast aluminum engines:

- **The Twin Super Husky; two cylinders, rated at 18 HP.**
- **The Super Husky; one cylinder, rated at 9 HP.**

Cushman Trucksters also now offer many other new advances — such as an extra-heavy duty clutch, synchro-mesh transmission, and auxiliary transmission* — to go along with these proven advantages . . . "all-muscle" chassis and body with 800 pound payload rating . . . greatest economy resulting from low initial investment, minimum operating and maintenance costs . . . general utility indoors or out, on or off street.

**Auxiliary Transmission optional; increases drawbar pull; eliminates strain of repeated starts and stops; produces smooth cruise at low speed. All-weather cab also optional.*

ACTUAL TRUCKSTER COST ANALYSIS NOW AVAILABLE

A coast to coast survey of typical Truckster users not only proves greatest economy, but reveals the wide range of uses to which the Truckster is being put.

Municipal uses ranged from mosquito control to park, cemetery and golf course maintenance . . . from trash collection to police and utility department service. Operating costs reported by municipal users ran as low as 0.66 cent a mile, and averaged 1.17 cents a mile.

Survey results have been compiled in condensed form and are available upon request.

Ask your dealer for a demonstration or write for FREE Cost Analysis Report and descriptive literature

CUSHMAN MOTORS 1027 No. 21st, Lincoln, Nebraska
A subsidiary of Outboard Marine Corporation

Please send Cost Analysis Report and descriptive literature.

NAME _____

TITLE _____

CITY _____ STATE _____

SETTLE DUST

FASTER

with Dow Calcium Chloride

You benefit three ways when you use Dow Calcium Chloride for dust control. *1. Settle dust faster.* Both Peladow and Dowflake attract moisture fast, hold it in hottest weather to keep roads moist and free of dust. *2. Stabilize unpaved roads.* You reduce gravel losses, blading costs by "fixing" loose surfaces with a moisture layer. *3. Stop complaints.* Minimize traffic hazards caused by dust clouds which obstruct vision.

Start your dust-control program *today* with Dowflake or Peladow. Write for free brochure—"Progressive Improvement of Secondary Roads."

PELADOW®
94-97%
Calcium Chloride

DOWFLAKE®
77-80%
Calcium Chloride

THE DOW CHEMICAL COMPANY
Midland, Michigan
DOW

To order these booklets check card opposite page 34.

WATER WORKS

Equipment For Water, Sewage and Industrial Waste Treatment

24. The complete line of Jeffrey equipment for treatment plants is covered in a 64-page Catalog 952 available from The Jeffrey Mfg. Co., Columbus 16, Ohio. Check the reply card for information on bar and disc type screens, traveling water screens, grinders, grit collectors, garbage grinders, sludge, draw-off valves, chemical feeders, bucket elevators and scum removers to mention some of the equipment.

Ball and Socket River Crossing Cast Iron Pipe

33. Literature is available describing Clow ball and socket cast iron pipe for river crossing, or any installation where full 15 degree free turning deflection is desirable. For description and specifications, address James B. Clow & Sons, Inc., P. O. Box 6600-A, Chicago 80, Ill.

Handbook of Cast Iron Pipes and Fittings

52. Full engineering data on products of the Alabama Pipe Co., including Super De-Lavaud cast iron pressure pipe and pipe fittings, valve boxes and other municipal castings are provided in Pressure Pipe Catalog No. 54, a 196-page publication of Alabama Pipe Co., Anniston, Ala. Weights, dimensions and specifications are clearly indicated in this easy to use reference.

Propeller Meters For Dependable Water Metering Control

53. The complete line of Measure-Rite propeller meters are described in Bulletin MR-105 available from Measure-Rite, Inc., 4545 W. Brown Deer Rd., Milwaukee 23, Wis. Check the card for details on these accurate meters.

Easily Cleaned Long Run Filter Bed Media

70. Bulletins on Anthrafilt tell the reasons why selected, graded crushed anthracite is superior to sand as a filtering material. Have you made a full investigation? Write Anthracite Equipment Corp., Wilkes-Barre, Pa.

100 Page Book Helps Solve Water Problems

71. pH and Chlorine Control. A discussion of pH, Chlorine and Phosphate Control and descriptions of comparators for making colorimetric analyses. A 100 page booklet is available by checking reply card. W. A. Taylor & Co., 7304 York Road, Baltimore 4, Md.

High Frequency Resistance— Welded Steel Pipe. .

72. Available in 6" to 16" diameters, in wall thickness to .219, special wrappings and coatings available. For attractive booklet, including specifications and details of field joints write Valley Mfg. Co., Valley, Neb., or circle our inquiry card.

Automatic Engine Control Equipment Manual

83. This catalog contains descriptions of standard automatic and semi-automatic controls and control equipment. General control recommendations, control selection chart, accessory selection chart, safety stop controls and alarm sets are sections covered. For price lists and models available write Synchro-Start Products, Inc., 8151 N. Ridgeway, Skokie, Ill.

A Handy List on "In Stock" Pipe

148. . . . is issued monthly by L. B. Foster Co. to show all stock footages of seamless and welded pipe, structural steel pipe and other specialties. Enables you to order pipe with exact knowledge of what is immediately available. Address L. B. Foster Co., P. O. Box 1647, Pittsburgh 30, Pa., or you can just check number on our card.

Rapid Sand and Pressure Filter Data

169. Rapid sand filters. A complete line of vertical and horizontal pressure filters, wooden gravity filters, and filter tables and other equipment. For engineering data, write Roberts Filter Manufacturing Co., 640 Columbia Ave., Darby, Pa., or check the reply card.

AWWA Fire Hydrants and Gate Valves

183. Above-ground maintenance Mueller AWWA improved fire hydrants and minimum maintenance Mueller AWWA non-rising stem gate valves are described in literature from Mueller Co., Decatur, Ill.

Heavy Duty Swimming Pool Equipment for Municipal Pools

193. Illustrated bulletin showing heavily built diving and deck equipment is available from American Playground Device Co., Anderson, Ind. Check the reply card for specifications on diving boards, data on diving stands towers, slides, pool ladders and pool cleaning

Manual on Pipe Finding Techniques

213. A manual on special pipe finding and leak detecting techniques of interest to utilities, municipalities, oil and gas companies is announced by Fisher Research Laboratory, Inc., 1961 University Ave., Palo Alto, Calif. The manual contains a number of articles on locating buried pipes and cables and detecting and locating fluid leaks in pipe lines.

Meters and Instruments For Water Works

224. An attractively arranged 40 page catalog in full color issued by Hersey-Sparling Meter Co., 225 No. Temple City Blvd., El Monte, Calif., furnishes concise data on the full line of Sparling meters, indicator-totalizer-recorder instruments and other special instruments and controls. Check the reply card for your copy, or write for Bulletin 315.

To Meet Increasing Water Demands, These Two Steps Will Help

247. Two new products designed to help meet constantly increasing demands for water are described in a folder of Hersey-Sparling Meter Co., 250 Elm St., Deham, Mass. These are a flow analyzer that provides strip chart rate of flow and volume records, and a two-rate register that can be substituted for the flow analyzer. Get this data by checking reply card.

Pipe Cutter for Cutting Large Size Pipe

254. An all-purpose pipe cutter that can cut pipe in or out of the ditch is described in a bulletin available from Ellis & Ford Mfg. Co., P. O. Box 308, Birmingham, Mich. Check the reply card for sizes and parts list.

A Quick Comparison of Water Meters Helps

274. That is the purpose of the new bulletin describing the newest accomplishments in water meter design and manufacture. With it comes a Condensed Catalog of the Rockwell line. Ask for Bulletin No. W-811 from Rockwell Mfg. Co., Municipal & Utility Div., 400 N. Lexington Ave., Pittsburgh 8, Pa.

Do You Know the Value of the V-Notch?

295. A new booklet tells what you want to know about how chlorine feeding can be made as regular and precise as the sunrise. Ask for "The V-Notch Story" direct of Wallace & Tiernan Inc., 25 Main St., Belleville 9, N. J., or check the card-number.

Kohler Standy-by Units Protection Against Power Failures

602. Dependable Kohler electric plants provide uninterrupted power for vital services when regular sources fail. Kohler Electric Plants World-Wide, folder E-402, illustrates models available for stand-by, sole supply, portable and marine applications. Sizes from 500 watt to 115 kw, gasoline, gas or Diesel operation. Write Kohler Co., Kohler, Wisconsin, or use the reply card.

NOW...the all-new BANTAM Compact 250

the all-purpose machine designed with tight budgets in mind!

Heavy-duty BANTAM 350 series—Most popular crane-excavators in their class. Widely used by public bodies everywhere for heavy-duty 11-ton performance—preferred because of rapid travel, wide work range and low-cost maintenance. Work with 11 BANTAM-built attachments. Wide choice of BANTAM-built carriers. Also crawler and self-propelled models.

Here is a small-size, mobile crane-excavator that is so versatile, it's virtually a *one-machine fleet!*

The all-new BANTAM Compact 250 is ideal for public service jobs of all kinds—taking the place of many other single-purpose rigs, reducing equipment costs and manpower needs.

Here is a compact machine that gives you all the benefits of cable and hydraulic operation—to speed up trenching, loading, handling, cleanout and hundreds of other vital public service jobs. Works with a full range of fast-change attachments for greater job range. Entirely BANTAM-built, including new, rugged 4 x 4 carrier. Or mounts on your own 4 x 4 or 4 x 2 truck.

Put this new compact-sized, compact-priced machine of wider work range in your plans now. Mail coupon.

This Is the BANTAM Compact 250:

- Fully flexible truck crane-excavator—high speed mobility plus wider work range.
- Lifts five tons . . . digs 100′ of 5′ trench per hour!
- More versatile—unlimited job range with full convertibility: back hoe (cable or hydraulic-actuated bucket) . . . crane . . . dragline . . . clamshell . . . shovel . . . etc.
- Ultra-simplicity—single-shaft machinery . . . cable-controlled digging-lifting operations . . . smooth, hydraulic 370° swing; foolproof mechanical controls.
- Faster: swing, raise boom, work attachments—all at same time with BANTAM's independent action and fastest line speeds.

301 Park Street, Waverly, Iowa, U.S.A.

SCHIELD **Bantam Co.**

World's largest producer of truck crane-excavators

Please send me complete literature and details on: PW-317

☐ BANTAM Compact 250.

☐ BANTAM 350 as ☐ Carrier Model, ☐ Crawler, ☐ Self-Propelled.

Name_____

Title_____

Address_____

City_____ Zone____ State_____

To order these helpful booklets check the reply card opposite page 34.

Diesel Engines For Municipal Power Needs

359. Dependable power for water supply or flood control pumping stations, stationary or portable electric plants and many other municipal needs can be provided by engines described in literature of the Enterprize Engine & Machinery Co., P.O. Box 2161, 550 85th Ave., Oakland 21, Calif.

Are You Using the Right Coagulant?

381. This question, and its answer, are included in new folder that packs much valuable guidance in water and sewage treatment. Read a little and learn a lot. Write to Tennessee Corp., Box 2205, Atlanta 1, Ga., or circle our card-number.

"A Coat in Time Saves Nine"

459. The solution to a wide variety of corrosion and deterioration problems is presented in a new 8-page bulletin on Bitumastic Cold-Applied Protective Coatings. Specifications, properties and applications of 9 major products are covered. Get your copy of Bulletin T-97-61 from Tar Products Div., Koppers Co., Inc., Koppers Bldg., Pittsburgh 19, Pa., by checking the inquiry card.

Handbook on How to Lay Concrete Pressure Pipe

524. Manual on concrete pipe laying instructions is available from Price Brothers Co., Dayton, Ohio. Check the reply card for information on how to dig the trench and handle the pipe, make the joint and the pipe bedding procedure.

In Tapping Machines Progress Never Ends

566. Now the B-100 double pressure chamber machine is available as described in new folder. Learn now what it can do for you by writing for Bulletin 8912 to Mueller Co., 512 W. Cerro Gordo, Decatur, Ill., or by circling our card-number.

A "New Look" in Magnetic Drive Water Meters

648. Easy-to-read features of the first magnetic drive meter with a disc meter chamber are illustrated and emphasized in Bulletin DER-961, available from Badger Meter Mfg. Co., 4545 W. Brown Deer Road, Milwaukee 23, Wisc.

Turn Your Water Meter Reading Inside-Out

671. The Visi-Meter is a remote recording and indicator system that eliminates the need of entering the home to read water meters. It records within an accuracy of 0.1 percent. Check the reply card or write Visi-Meter, Inc., 301 North 17th St., Kansas City, Kans., for literature.

Electronic Locators for Water Mains, Services, Valves and Boxes

677. Miniaturized line locator that is encased in a molded glass fibre container and has transistors that have a rated life of 70,000 hours and weighs only four lbs. when completely assembled is described in literature from Wilkinson Products Co., 3067 Chevy Chase Drive, Pasadena 3, Calif. Check the reply card.

Get the Sand out of Your Meters and Pumps

680. There is a way to do this, the new Krebs centrifugal water/sand separator. How it does this is the subject of helpful literature to be had direct from Equipment Engineers, Inc., 737 Loma Verde Ave., Palo Alto, Calif., or by checking our card-number.

Bulletin Covers Step-by-Step Action on the Water Problem

689. A step-by-step outline of action telling how the responsible citizens can help their officials extend and improve the local water system through more adequate rate structures on financing is covered in this bulletin available from Thos. F. Wolfe, Managing Director, Cast Iron Pipe Research Association, 3440 Prudential Plaza, Chicago 1, Illinois.

Water Filtration Costs Can Be Reduced

692. The "Celite" system of diatomite filtration makes possible reduced installation cost, with space requirements a fraction of those for equivalent sand filtration. For informative literature write Johns-Manville, Box 14, New York 16, N.Y.

Measure Water Accurately In Open Ditches and Channels

694. Parshall Measuring Flumes are widely used by Irrigation Companies, Farmers, Cities and Industries. All steel construction assures accuracy within 2%. Available in sizes for 0.1 to 1340.0 cubic feet per second. Catalog B-31-C contains free-flow discharge tables, sizes, capacities and weights. Thompson Pipe & Steel Co., 3025 Larimer Street, Denver 1, Colorado will send you a free copy for the asking.

●

ODOR CONTROL

For Rest Area Odor Control

324. Whether your problem is located out on the highways or in urban areas this circular describes how to end smells by destroying the bacteria which create them. Simple, swift, sure. Get information from Werley Chemical Supply Co., 1505 Broadway, Cleveland 15, Ohio, or circle number on reply card.

Make Your Citizens Happier by Controlling Irritating Odors

665. Whether these come from treatment plants, incinerators, dumps, sewer manholes or lift stations improve your public relations through effective combating of odors. Descriptive literature telling how to do it can be had from Sanfax Corp., P. O. Box 604, Atlanta, Ga., or by using our reply card.

(More listings on page 52)

Your Problem:
LEAVES & CATCH BASINS
Your Answer:
The GOOD ROADS
SCAVENGER
Powerful multi-purpose unit. Vacuums leaves and debris. Cleans catch basins in minutes to 8 ft. depths. Send for brochure.

Manufacturers of Snow Plows, Road Spreaders, Leaf & Litter Equipment

Good Roads GOOD ROADS MACHINERY CORPORATION
MINERVA, OHIO

No other filtering medium compares with

ANTHRAFILT®

Anthrafilt stands alone as the one Filtering Medium that is best for all types of filters!

Years of efficient and economical use in every type of filter plant have made ANTHRAFILT the standard of excellence in the filtering medium field.

ANTHRAFILT

offers important advantages over sand and quartz

DOUBLES length of Filter runs • REQUIRES only half as much wash water • KEEPS Filters in service over longer periods • INCREASES Filter output with better quality effluent • GIVES better support to synthetic resins • PROVIDES better removal of fibrous materials, bacteria, micro-organic matter, taste, odor, etc. • IDEAL for industrial acid and alkaline solutions • EFFECTIVE filtration from entire bed • LESS coating, caking or balling with mud, lime, iron, or manganese.

IDEAL FOR USE IN EVERY TYPE OF FILTER

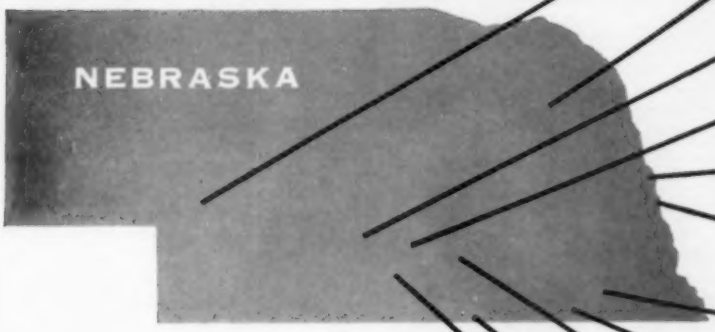
For further information, test samples, quotations or nearest dealer, write to:

PALMER FILTER EQUIPMENT CO.
P. O. Box 1696—822 E. 8th St., Erie, Pa.

Representing:
ANTHRACITE EQUIPMENT CORP.
Anthracite Institute Bldg., Wilkes-Barre, Pa.

NEBRASKA COMMUNITIES SELECT COILFILTERS

. . . WITH EMPHASIS UPON FRESH SOLIDS DEWATERING



OGALLALA
Fresh Solids
Cons. Eng. Nosky & Hickey

NORFOLK
Fresh Solids
Cons. Eng. Leo A. Daly Co.

COZAD
Fresh Solids
Cons. Eng. Nosky & Hickey

KEARNEY
Fresh Solids
Cons. Eng. Henningson, Durham & Richardson

OMAHA
Digested-Activated
Cons. Eng. Henningson, Durham & Richardson

EAST SARPY CTY.
Fresh Solids
Cons. Eng. B. H. Backlund & Assoc., Inc.

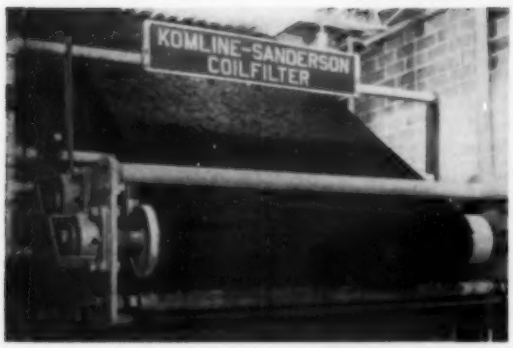
BEATRICE
Fresh Solids
Cons. Eng. Henningson, Durham & Richardson

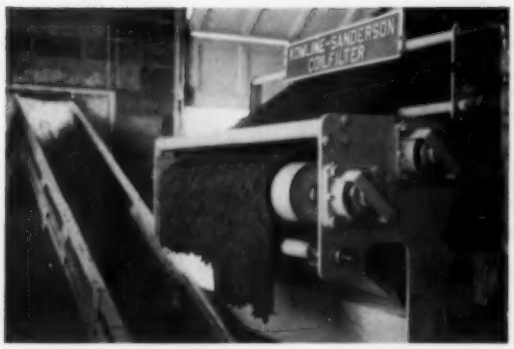
FAIRBURY
Fresh Solids
Cons. Eng. Henningson, Durham & Richardson

HASTINGS
Fresh Solids
Cons. Eng. Henningson, Durham & Richardson

SUPERIOR
Fresh Solids
Cons. Eng. Mousel & Wright

HOLDREGE
Fresh Solids
Cons. Eng. Henningson, Durham & Richardson





Since the first Coilfilter installation in the state, in 1957 at Hastings, Nebraska communities have chosen Coilfilters exclusively for sewage sludge dewatering.

Of the eleven installations named above, ten are for dewatering fresh solids, indicative of the popularity and reliability of that type of sludge dewatering.

Whatever the type of sewage sludge to be dewatered, Coilfilters have proved, time after time, that they can outperform all other sludge dewatering devices.

KOMLINE-SANDERSON ENGINEERING CORPORATION

PEAPACK, NEW JERSEY • BRAMPTON, ONTARIO, CANADA

MANUFACTURER OF COILFILTER SLUDGE VACUUM FILTERS AND AUXILIARY EQUIPMENT FOR DEPENDABLE FRESH SOLIDS DEWATERING

NEW LEECE-NEVILLE 40-AMP ALTERNATOR

6000-series alternator answers the need for adequate electrical power at lower cost

Leece-Nevilie, since 1946 the pioneer and leading supplier of alternators for heavy duty automotive service, announces a new, compact 40-Ampere alternator priced in line with comparable DC generators.

If you experience costly battery failures and other electrical system troubles with vehicles in your fleet, but feel that the money difference for 50 to 60-Ampere alternators previously available is too much to justify in your type of operation, Leece-Neville's new 6000-Series Alternator is the ideal solution. Under normal operating conditions, this power-packed alternator has a 40-Amp rating, and delivers 5 to 10 amperes at curb idle. With this unit, your battery is used only for starting the engine, remains charged at all times.

The new L-N 6000-Series Alternator is backed by Leece-Neville's 14 years of extensive field experience with heavy duty alternators, and by a 50-year reputation for building quality electrical equipment. Designed and constructed to Leece-Neville's usual heavy duty concepts, it will be available as factory-installed special equipment through almost all vehicle manufacturers.

RUGGED DESIGN . . . QUALITY CONSTRUCTION . . . HIGH PERFORMANCE AT LOW COST

- Compact and lightweight for savings in both space and weight.
- High performance 40-Amp rating at low cost in line with comparable DC generators.
- 5 to 10 amperes at curb idle.
- Replaceable built-in Silicon rectifiers mounted in separate high efficiency heat sinks, and protected from alternator heat (stator and rotor heat losses).
- Sealed anti-friction ball bearing at the drive end . . . efficient roller bearing at slip ring end.
- Slip ring assembly fully shielded to protect brushes and slip ring from contamination, assuring long life.
- Exclusive soldered connections between heat sinks and rectifier cells for better electrical and thermal conductivity.
- Silicon diodes (rectifiers) have built-in overload and high temperature capacity.
- Self-limiting current requires only simplified voltage regulator.
- Positive or negative ground types available.
- 6-volt types available.
- Reversible—clockwise or counter-clockwise rotation, limiting stock requirements.
- Heavy duty design concepts (protected windings, splash proofed, etc., at no extra cost to you).

TYPICAL TYPES OF SERVICE WHERE THE 6000-SERIES ALTERNATOR WORKS LIKE A TROJAN

Door-to-door Delivery
Taxis, Officials' Cars
Motor Freight
Civil Defense
Utility Companies
Construction
Ham Radio Cars
Suburban Police Units
Air Conditioned Cars
And many, many more—including your personal car!

ALTERNATORS FOR ALL! Leece-Neville offers you alternators for *every* type of service, from passenger car to the biggest truck or tractor—all designed to save batteries, cut maintenance costs and practically eliminate downtime caused by electrical failure. For more information about the new 6000-Series Alternator, or alternators for heavy duty service, just mail the coupon at the left.

QUALITY ELECTRICAL EQUIPMENT
Leece-Neville
SINCE 1909

The Leece-Neville Company, Dept. PW-5
1374 East 51st Street • Cleveland 3, Ohio

Please send me more information on:
☐ 6000-Series Alternator
☐ Heavy Duty Alternators

Name _____ *Title* _____
Company _____
Address _____
City _____ *Zone* ____ *State* _____
Type of Service _____

LEECE-NEVILLE
6000-SERIES ALTERNATOR
40 Amp rating 5-10 Amps
at curb idle

COMPACT...LIGHTWEIGHT...
HIGH PERFORMANCE...LOW COST

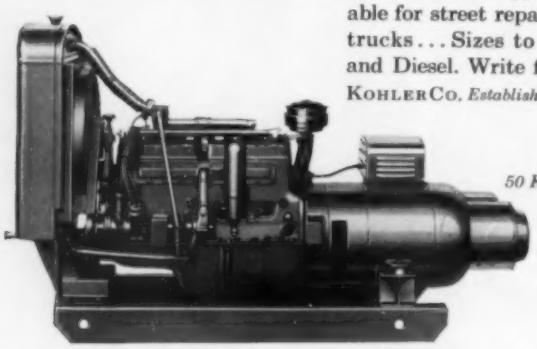
Vital safeguard when power fails...

KOHLER ELECTRIC PLANTS

for filtration and treatment plants

When storms or accidents cause power stoppage, Kohler stand-by electric plants provide immediate electricity for equipment essential to public welfare in sewage treatment and filtration plants. Easy to install and maintain, they are completely packaged units with all accessories for full, unattended protection. Known everywhere for reliability . . . Lightweight, portable, sole supply models are available for street repair and maintenance trucks . . . Sizes to 115 KW, gasoline and Diesel. Write for folder L-28.

KOHLER CO. *Established 1873* KOHLER, WIS.



MODEL 50R81,
50 KW, 120/208 volt AC.
Remote start.

KOHLER OF KOHLER

ENAMELED IRON AND VITREOUS CHINA PLUMBING FIXTURES • ALL-BRASS FITTINGS
ELECTRIC PLANTS • AIR-COOLED ENGINES • PRECISION CONTROLS

STREETS AND HIGHWAYS

How to Prepare and Maintain Roadways With Calcium Chloride

65. "The Calcium Chloride Road," is the name of a new 24-page two-color catalog issued by the Pittsburgh Plate Glass Co., Chemical Div., 632 Fort Duquesne Blvd., Pittsburgh 22, Pa. Included are sections on dust control, gradation, placing and mixing materials and shaping. General information on spring, summer and fall maintenance is also provided.

Why Sod or Plant?

113. . . . when you can establish a grass area in 18 to 21 days merely by rolling it in place. TroyTurf carpets are presseeded and prefertilized and can be placed by hand or tractor on level areas or 85° slopes if desired. Write for TroyTurf bulletin, Troy Blanket Mills, 200 Madison Ave., New York 16, N. Y. or circle the reply card.

Chip Dollars from Your Overhead With Fitchburg Chippers

160. Detailed cutaway drawings, specifications, diagrams, charts and money-saving reports and experiences are covered in catalog available from Fitchburg Engineering Corp., Dept. PW, Fitchburg, Mass.

How Are Your Bridge Floors?

185. If you face replacements—or plan new bridges—you will find much really helpful data on steel mesh bridge flooring, safety features, tractional surfaces, dimensions, weights, loads and spans in a new booklet offered by Irving Subway Grating Co., Inc., 50-09 27th St., Long Island City 1, N. Y. Includes detail drawings, specifications, also data on bridge sidewalks. Write for "Irvico Decking" booklet today

Polysulfide Epoxy Resin Adhesives for Concrete

186. Thiokol LP-3/epoxy resin concrete adhesives are especially suited for use in maintaining or repairing concrete structures. Check the reply card or write Thiokol Chemical Corp., Trenton 7, N. Y., for details on testing and application and working properties.

Illustrated Specifications on Brush and Limb Disposal

222. A new booklet on the modern approach to the brush problem shows how an Asplundh chipper reduces bulky branches and brush trimmings to chip size for mulch or easy removal. Write Asplundh Chipper Company, 501 York Road, Jenkintown, Pa., or use the handy reply card.

Stumped by Stumps?

303. Pow-R-Stump cutter is operated by one man, handles stumps of any width and up to 33 ins. in height and will not damage curbs, driveways or sidewalks. For literature check the reply card or write Vermeer Mfg. Co., Pella, Ia.

Everybody Else May Have Automotive Battery Problems—

401. . . . except those who have read the Leece-Neville folders on their alternator-generator systems, and then done something about it. Have less trouble by taking the trouble to write for these bulletins, to The Leece-Neville Co., 1374 East 51st St., Cleveland 3, Ohio, or ring the card-number.

To Get People or Products Around Fast

424. Look into this line of gas and electric Trucksters. 6-page 4-color bulletin describes these vehicles used for transporting personnel and materials. Ask for brochure "They're All Muscle" from Cushman Motors, Lincoln, Neb.

Data on Portable and Stationary Air Compressors and Accessories

652. Covered in literature available from Gordon Smith & Co., Inc., Bowling Green, Ky., are the basic designs of portable air compressors, models, operating features and specifications. Check the reply card.

(More listings on page 56)

Want better scraper versatility?

the TS-14 all-wheel drive "Euc" is the answer!

Whatever your scraper requirements may be, the Euclid TS-14 can cut earthmoving costs on a wide range of work—from small yardage jobs to the biggest projects.

All-wheel drive and 14 yd. struck capacity puts this "Euc" way ahead of other medium size scrapers in performance and overall work-ability. With a total of 296 h.p. and separate Torqmatic Drive for each axle, the TS-14 picks up heaped loads in a hurry... gets out of the borrow pit or cut fast... and really rolls on the haul road. It loads itself in practically any material... and with a push tractor it's a big producer on the toughest scraper job.

Here's a one-man earthmover that reduces your equipment investment... works more days per year... handles a wider range of work because it isn't stalled by steep grades or adverse conditions. Ask your dealer for complete information... better yet, have him show you a TS-14 in operation.

EUCLID Division of General Motors, Cleveland 17, Ohio

Plants at Cleveland and Hudson, Ohio and Lanarkshire, Scotland

GM GENERAL MOTORS EUCLID

EUCLID

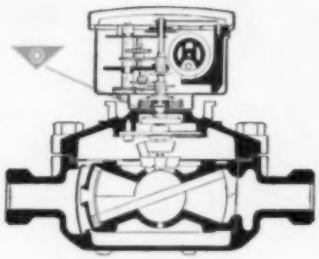
FOR MOVING EARTH, ROCK, COAL AND ORE

NOW THE FIRST MAGNETIC DRIVE

Only the Badger Easy-Read* offers . . .

REMOVABLE REGISTER

BOLD NEW FACE



SAPPHIRE JEWEL BEARING

Magnetic drive is even bigger news in Badger's Easy-Read water meter, where it combines with the long-accepted superiority of disc meter performance.

The new Easy-Read has no troublesome stuffing box, no consequent drags or leaks. It's sealed tight against water, dirt, fogging, tampering and corrosion.

But *only* the Easy-Read provides these: a low-friction, self-cleaning sapphire jewel bearing that acts as a buffer for the magnetic coupling . . . a new exclusive removable register . . . the largest, most readable face (its digits ¼" tall) of any meter.

Plus interchangeability of parts—permitting you to modernize your present Badger meters just by replacing certain parts.

Easy-Read meters are made in ⅝", ⅝" x ¾", ¾" and 1" sizes in split case and frost-proof models. Also 1½" and 2" sizes in split case type. *Shown at right:* ⅝" x ¾" split case and (smaller illustration) ⅝" x ¾" frost-proof Easy-Read meters.

Ask your Badger representative for complete details. Or write to the address below for new, 4-page Easy-Read bulletin.

*Trademark

Split case Easy-Read meters

¾" 1" 1½" 2"

Badger Meter Mfg. Company

4545 West Brown Deer Road • Milwaukee 23, Wisconsin

METER WITH A DISC METER CHAMBER

To order these helpful booklets check the reply card opposite page 34.

The Trucks You Need for Every Public Works Job

461. Extra life and operating economies are built-in features of every Ford truck model. There's a chassis size and engine for each of your needs, from light utility work to heavy-duty construction jobs. Get latest literature from Ford Motor Co., Truck Div., Dearborn, Mich. by checking the reply card.

64-Page Manual On Surface Treatments

484. Complete up-to-the-minute information on all types of surface treatments is covered in manual available from American Bitumuls & Asphalt Co., 320 Market St., San Francisco 20, Calif. The Manual provides on-job reference as well as engineering department use and it covers every step from pavement inspection to traffic-control on the finished pavement.

"Hottest Street Patcher in Town after Town"

506. This is the modest title of a circular depicting and describing portable heated rollers for the patching crew. Well worth your attention. Get it from Ellis Distributing Co., Box 168, Liberty, Mo., by checking reply card.

Salt, Sand and Cinder Spreaders

532. . . . are fully discussed in folder No. A-450 outlining how these are dump body mounted for quick attachment and detachment according to service and season. Basic specifications outlined. Just address Baughman Mfg. Co., Jerseyville, Ill. or use the reply card.

For Soil Sampling and Pavement Coring

576. There's an easier way to do both with Acker equipment. Bulletin 26-R describes a kit containing 12 different soil sampling tools. Bulletin 40-R tells about the All-Purpose auger for all types of sub-surface exploration. Bulletin 700-R illustrates the Acker Shear Test Kit for in-place shear tests in soft areas. Name the ones you want. Acker Drill Company, Inc., Box 830, Scranton, Pa., or check our card.

Variable Pitch Rotaries for all Mowing Requirements

601. The Roof VP Mower with blade pitch adjustment for different cutting conditions handles all mowing chores from dense weed removal to park lawns. Check this heavy-duty equipment for your turf maintenance needs. Data from Roof Mfg. Co., 1228 North Walnut St., Pontiac, Illinois, or check the reply card.

Public Works Equipment for Everyday Use

578. How many everyday public works needs can be met by the products of one company is the basic content of this brief but informative brochure. Inform yourself with a copy of it. Address Allis-Chalmers Mfg. Co., Box 512, Milwaukee 1, Wisc., or ring the number on card herewith.

Complete Line of Asphalt Patching Mixers

586. Mixers capable of mixing 3 to 20 tons of hot mix per hour are described in literature available from McConnaughay Mixers, Inc., Lafayette, Ind. Check the reply card for full information on patching, repairing, resurfacing and sealing.

Specification Sheets on John Deere Tractors and Equipment

588. Information and specifications on the John Deere crawler and wheel-type industrial tractors and working equipment. Deere & Co., Industrial Division, Moline, Ill. Check the reply card. State type of tractor and equipment

Vacuum Cleaner and Leaf Collector For Cleaner Streets

595. A unit is now available that can be mounted on a right-hand drive jeep or a pick-up truck for picking up gutter trash and leaves. Complete specifications, capacity, operation and installation procedures are covered in a bulletin available from Tarrant Mfg. Co., Saratoga Springs, N. Y.

Here's a King-Sized Sucker-Upper . . .

656. . . . that will rid your streets and gutters of leaves, litter and other bulky materials in record time. Cleans catch basins to 8-ft. depth in minutes. Bulletin PL 758 S describes and illustrates this motorized Scavenger. Address Good Roads Machinery Corp., Minerva, Ohio, or circle number on card.

100 HP Motor Grader

715. Model 330-H features a constant-mesh transmission, 8 forward and 4 reverse speeds, full-diesel rubber-mounted engine. With hydraulic brakes, ample strength and weight, and a wide range of blade adjustments. Write for bulletin (Form No. M6-174) from LeTourneau-Westinghouse Company, Peoria, Illinois, or circle reply card.

WEED CONTROL

Chemical for Roadside Weed Maintenance

234. Garlon is an easy to prepare and to use chemical in the control of roadside weeds and growth. For complete data write The Dow Chemical Co., Agricultural Chemicals Sales, Midland, Mich., or check the reply card.

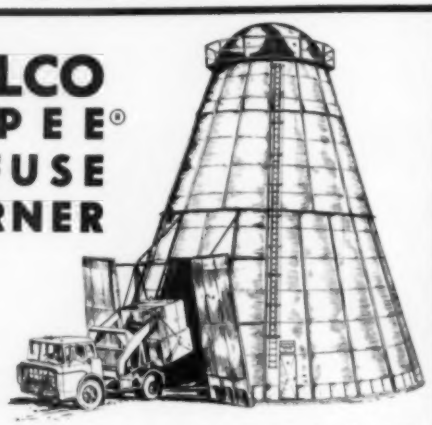
Weed Control Costs

308. Information on a weed killer that can save hundreds of man-hours of clearing and cutting is available from Diamond Alkali Co., 300 Union Commerce Bldg., Cleveland 14, Ohio. Whether you want to control weeds or brush or both, without damage to crops or ornamentals get this literature today by checking the reply card.

Don't Fool Around with Weeds —Eliminate Them

599. With Amizol and Amizol combinations, advantages are better kills, lower costs, longer spraying seasons. For full-color brochure that tells the whole story of better weed and vegetation killing, address AMCHEM Products, Inc., Ambler, Pa., or circle card-number.

WILCO TEPEE® REFUSE BURNER



- Engineered Triple Draft assures fast, clean burning with maximum safety.
- Pre-fabricated in 10 sizes from 15 to 67½ ft. diameter to meet all municipal, community and industrial requirements.
- Big-panel construction makes erection fast and easy.
- Provides lowest-cost incineration per ton with batch loading or continuous feed. Truckloads at a time—no operator required.
- Efficiently burns all types of combustible waste, trash and garbage—no firebricks to maintain.

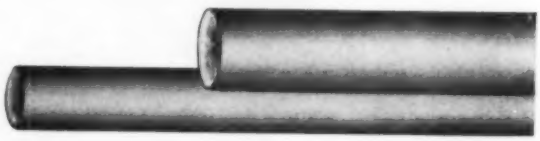
Hundreds of Wilco Refuse Burners are serving colleges, prisons, communities, municipalities and industry. Write, wire or call today for full information on the burner to meet your needs. Approved by fire underwriters.

wilco machine works, inc.

Phone WH 8-4555 Box 3897 PW-2 Memphis 14, Tenn.

high frequency, resistance welded

Authorized by A.P.I. under Spl. 5L and 5LX where applicable



If you want a closer source for pipe that meets the highest standards, better talk to Valley. Ideal as line pipe for gas, water, air conditioning ducts, grain spouting, etc. Special wrappings and coatings. Steel piling also available.

Sizes 6 5/8" to 16" Wall Thickness to .219

write or call Dept. W

VALLEY MANUFACTURING COMPANY
VALLEY, NEBRASKA

He's About to Bend An Armco Gate Stem

...so the one you specify won't

Stainless Steel Gate Stems, optional on all Armco Slide or Sluice gates, were developed by Armco's Research Laboratory to assure you of durability and strength. Here, a research technician performs a columnar test to determine strength factors and constants.

In addition to laboratory experiments, in-service tests prove the high strength, high resistance to buckling and excellent corrosion resistance of stainless steel make it ideal for gate stems in sewage and water control.

All these tests add up to one thing: stronger, more durable gates for you. For complete information on Armco Gates, mail the coupon.

Strong, Durable, Economical

Steel

New steels are born at Armco

Armco Drainage & Metal Products, Inc.,
6471 Curtis Street, Middletown, Ohio.
Send me information about Armco Gates.

Name _____

Address _____

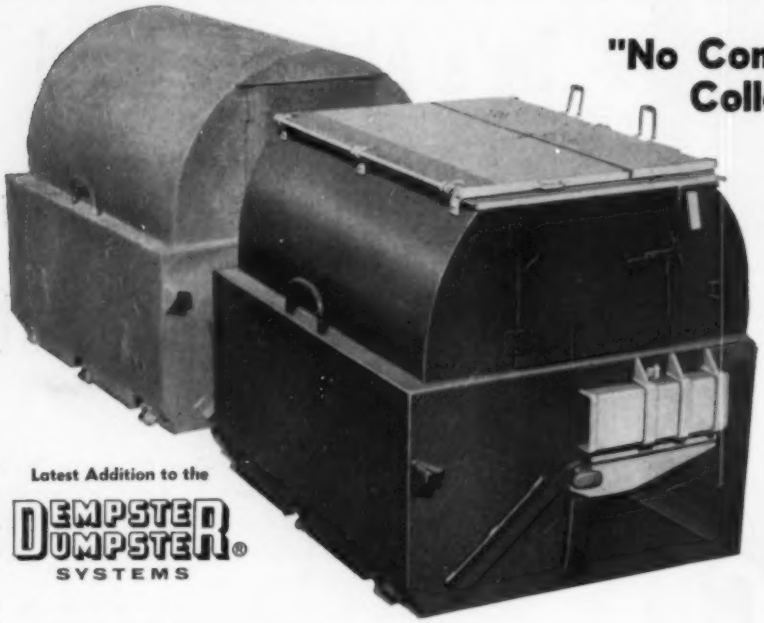
City _____

State _____

Phone _____

ARMCO Drainage & Metal Products

New SUPER DUMPMASTER Handles Converted DUMPSTER Containers...Beats Long-Haul Problem



Latest Addition to the DEMPSTER DUMPSTER® SYSTEMS

"No Container Haul System" Collects Refuse on Spot

If longer trips to disposal areas have raised your operating costs, a small investment in conversion kits protects large investments in DUMPSTER containers. The Super DUMPMASTER handles converted DUMPSTER containers up to 12 cu. yd. and all DUMPMASTER containers one thru 12 cu. yd.

Mfd. Only By DEMPSTER BROTHERS Inc.

Owners of DEMPSTER-DUMPSTER Systems who now face long haul problems due to movement of disposal areas may now convert from their present "container haul" system to the new SUPER DUMPMASTER "no-container-haul" system without abandoning their investment in DUMPSTER Containers.

The SUPER DUMPMASTER makes its rounds to each converted container, mechanically empties the contents into its 30 cu. yd. packer body and compacts the material to a fraction of its former volume with the 85,000 lb. force of its packer plate. Rather than haul each container to the disposal area, the SUPER DUMPMASTER carries the contents of many containers on each trip, cutting collection costs drastically.

Write Today for FREE BROCHURE

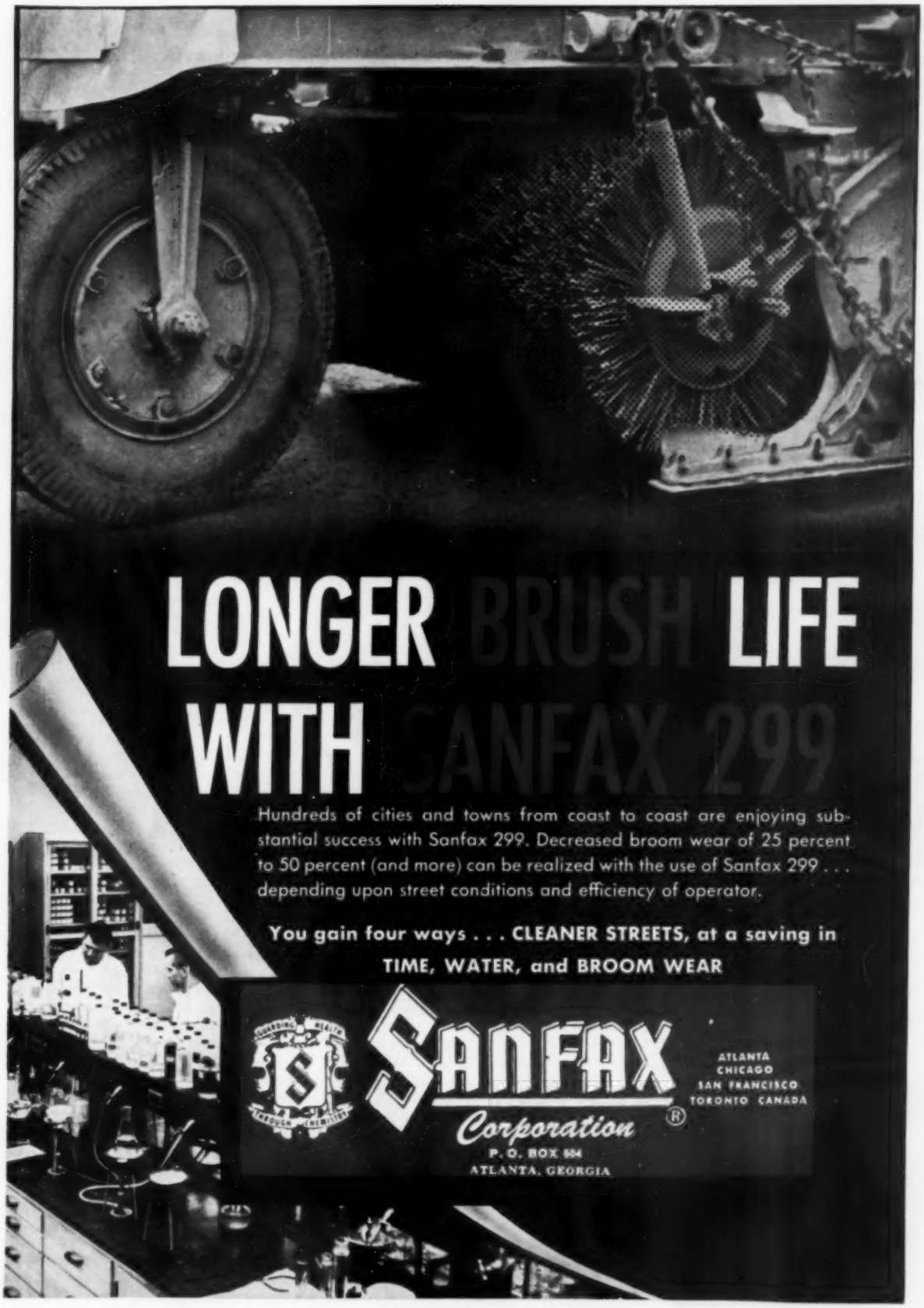
DEMPSTER BROTHERS Inc.

DEPT. PW-5, KNOXVILLE 17, TENN.

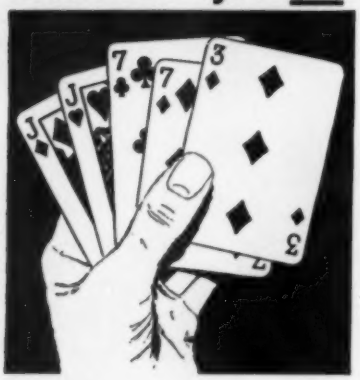
The SUPER DUMPMASTER engages container.

Clearance arms carry it toward hopper opening.

Container is rotated, emptying contents into the compaction body.


LONGER BRUSH LIFE
WITH SANFAX 299
Hundreds of cities and towns from coast to coast are enjoying substantial success with Sanfax 299. Decreased broom wear of 25 percent to 50 percent (and more) can be realized with the use of Sanfax 299 . . . depending upon street conditions and efficiency of operator.
You gain four ways . . . CLEANER STREETS, at a saving in TIME, WATER, and BROOM WEAR
GUARDING HEALTH
S
PROTECTS CHILDREN
SANFAX
Corporation
P. O. BOX 604
ATLANTA, GEORGIA
ATLANTA
CHICAGO
SAN FRANCISCO
TORONTO CANADA

POKER? Play to win!



How would you play this hand?

Not strong, but play it. Two times in three you'll be high hand before the draw. Raise to drive out pairs. Then stand pat. It's 12 to 1 you couldn't fill anyhow, and it helps set up later, better hands.

Here's a sure winner from FORD:

New Ford 4000 Heavy Duty Fork Lift! Strength, stability and big-tire traction for fast, safe materials handling on rough terrain.

4000 lbs. rated load at 24" load center. Conforms to or exceeds all Fork Lift Industry stability and capacity recommendations.

Five basic models with 10' to 21' lift heights. Two and three-stage telescoping masts with unusually low collapsed heights. Especially built for rough terrain. Its mobility and low collapsed mast height adapt it for work in many areas with low doorways and narrow aisles.

Get details from your Ford Tractor Dealer, or write:

Tractor and Implement Division
Ford Motor Company
Birmingham, Michigan

Ford
TRACTORS
EQUIPMENT

LEGAL ASPECTS OF PUBLIC WORKS

MELVIN NORD, Dr. Eng. Sci., LL.B.

Duty of Owners to Repair Sidewalks

City of Rapid City v. First National Bank of the Black Hills, 107 N. W. 2d 693, a South Dakota case decided Feb. 16, 1961, was an action by a City which had paid a substantial judgment for personal injuries resulting from a fall by a pedestrian on a sidewalk, against the abutting property owner, the First National Bank of the Black Hills, to indemnify the City for the amount of the judgment.

Under standard principles of law, a municipality has full and complete control over public sidewalks within its corporate limits. Consequently it is charged with the affirmative duty of keeping its sidewalks in a reasonably safe condition for pedestrians, and is liable for injuries for its negligence in this respect. (By statute, it is provided that the City has no immunity from tort liability in such cases.) On the other hand, there is no common law duty of an abutting owner owing to the general public to maintain the sidewalk in repair. Of course, if the abutting owner creates an artificial condition on the sidewalk which interferes with public travel, this constitutes a public nuisance, and if it causes an injury to an individual in such case he can recover from the abutting owner.

The City contended, however, that this is changed by a statute which provides that if an abutting owner fails to keep the sidewalk in repair, he is liable to the municipality for any damage caused by such neglect. In the present case, moreover, the City had notified the Bank of the defective condition of its sidewalk, and notified the Bank that if it did not repair the sidewalk the City would do so and assess the cost to the Bank. The defective sidewalk was not replaced, however, and Mary Gurney fell, was injured on it, and recovered a judgment against the City as a result.

The court pointed out that in most States, the statute only permits the municipality to repair the sidewalk and assess the cost to the abutting owner. However, in the present case, the South Dakota statute clearly makes the abutting owner secondarily liable to the municipality for all damages resulting from his failure to repair the sidewalk after notice of a defect.

Consequently, the court held that the abutting owner must indemnify the City against the loss suffered by it under the judgment.

Municipal Dump

Greer v. City of Lennox, 107 N. W. 2d 337, a South Dakota case decided Feb. 2, 1961, was an action by the owner of a farm adjacent to a public dump maintained by the City for damages on the ground that the maintenance of the dump constituted a nuisance. He recovered a judgment for $5000, and the City appealed to the State Supreme Court.

In 1953 the City of Lennox purchased a gravel pit for use as a public dump. It is located on land immediately north of plaintiff's farm. The driveway to the dump runs north off the township road about 50 rods west of plaintiff's driveway. In April 1954 the City closed its old dump north of town and commenced using the gravel pit as a public dump for the disposal of refuse and garbage. This refuse and garbage was collected daily by a city employee from residents of Lennox. All manner of waste, refuse, and offal were dumped by the City and others at the site—dead chickens and animals, rotten eggs, raw garbage, spoiled meat, rotten fruit, and contents of cesspools. Inflammable materials were burned "every day it was fit" and twice a year a

MODEL DAM BY R. S. BALDWIN

When it comes time to appoint a trustee or fiscal agent for revenue bonds, The Chase Manhattan Bank is at the service of state, county and municipal authorities. Chase Manhattan has the staff and experience to handle this function as trustee or fiscal agent in cooperation with banks in the areas where the projects are located. For complete details write: Corporate Trust Division, The Chase Manhattan Bank, 1 Chase Manhattan Plaza, New York 15.

FINISH FASTER WITH ALLIS-CHALMERS EQUIPMENT

5 combinations like this **1** just right—for loading light material or heavy excavating . . . for shallow ditching or 13-foot-deep trenching. There's an Allis-Chalmers unit to match your job.

Allis-Chalmers tractors have the profile to mount equipment efficiently . . . the stamina to get the most out of the equipment for extra profit on so many jobs.

Matched loaders and backhoes are rugged . . . handle big payloads . . . trench swiftly for greater profit.

Find out firsthand how low-profile stability, high-clearance maneuverability, **SHUTTLE clutch** direction reversing and matched Allis-Chalmers equipment can add up to more profit for you. Ask your Allis-Chalmers utility tractor dealer for the FACTS, or write Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

bulldozer was used to shove the refuse down. Also the City commenced poisoning rats shortly after the dump was opened.

Before the dump was established plaintiff's premises were in good repair and free from rats and offensive odors. Afterwards, his farm was infested with rats, flies and noxious odors. The rats were particularly bothersome and destructive. They undermined foundations causing them to sag and break. They damaged sills, floors, lower siding boards, and door frames. They caused fear and inconvenience and prohibited the use of the basement in the house. Plaintiff incurred expense in fighting the rats, repairing damaged buildings and fanning grain. He sustained loss of crops, chickens and feed grain, and loss of value in his buildings.

The City was aware of the condition. Complaints were made by plaintiff. The matter was discussed at meetings of the City Council. It was the subject of local newspaper comment. The mayor and various city officials inspected the damage to plaintiff's property. On one occasion the City furnished a supply of rat poison to plaintiff. In 1958 it retained the services of an expert exterminator. Nevertheless, up to the time of trial in November, 1959, the rats continued to invade and infest plaintiff's premises.

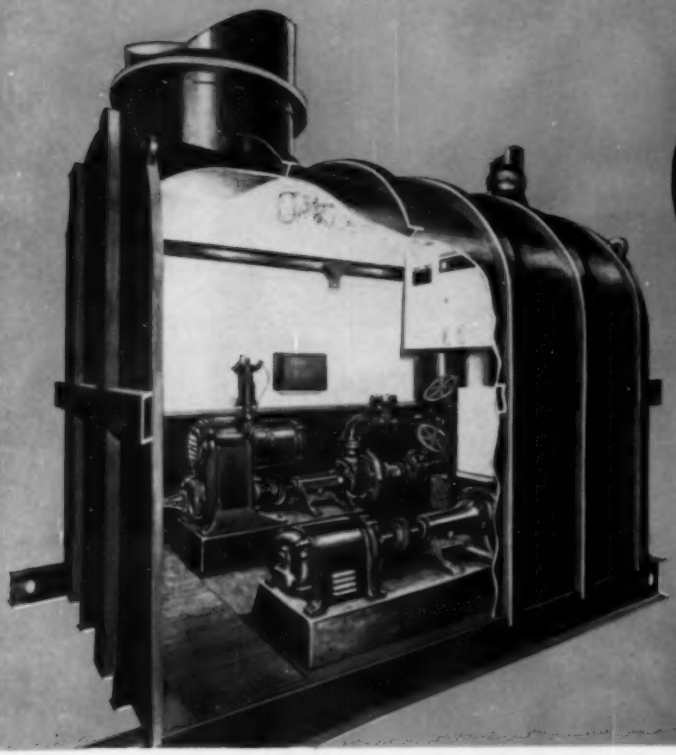
The City defended on the ground that it had statutory authority to maintain a dump, and that since this was a governmental activity, it was immune from tort liability.

The court held, however, that if a dump is operated so as to constitute a nuisance, as was the case here, there is no immunity. It therefore affirmed the judgment of the trial court holding the City liable.

• • •

Intapuc Conference On Public Cleansing

The International Association of Public Cleansing will hold its Seventh Conference and Exhibition at Goteborg, Sweden, from September 4th to 8th next. The conference will meet in the Concert Hall and the Exhibition will be in the Industrial Hall at the Fair Ground near by. Among the speakers will be Paul R. Screvane, formerly Commissioner of Sanitation, New York, and Arne Benten, Chief of Goteborg City Work Study Department. Prospective delegates and exhibitors should get into touch with Intapuc, Postbox 341, Goteborg 1, Sweden.

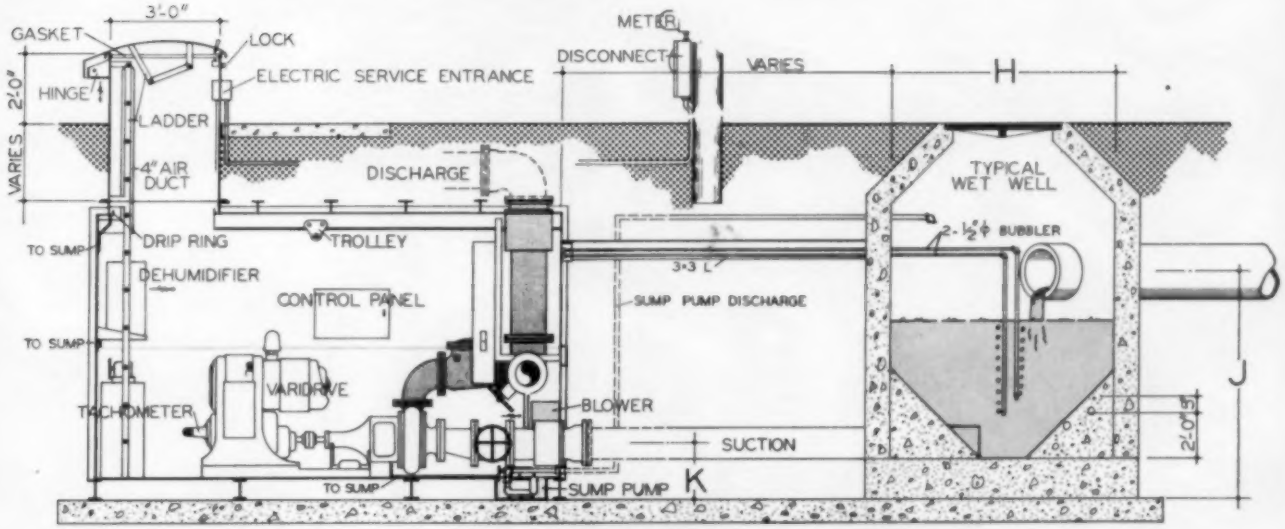


TEX PACKAGED QUAD PUMP STATION

the 1st PACKAGED PUMP STATION DESIGNED TO FIT THE EQUIPMENT

MORE USABLE FLOOR SPACE

- More Room For Future Expansion of Pumping Units
- More Room For Servicing of Equipment
- More Room To Use Variable Speed Pumps To Match The Pump Capacity To The Rate of Sewage Inflow



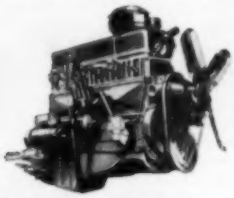
Write Today for the New TEX-QUAD CATALOG No. TQ-61. It Gives Complete Information On This New, Rectangular Packaged Pump Station.

TEX-VIT MANUFACTURING COMPANY
Formerly TEX-VIT Supply Company
P. O. BOX 117-P MINERAL WELLS, TEXAS

CHEVROLET

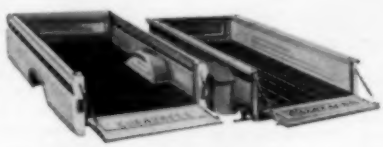
HERE'S WHY IT'S A GOOD IDEA TO GET A CHEVY PICKUP:

Because Chevy's wide choice of models (there are 15 of 'em!) means you'll get the *right* pickup . . . because each is engineered to the highest standards . . . because Chevy's rugged, smooth-riding build lasts longer, costs you less to own and keeps your profits at peak levels. Chances are, whatever you consider most important, you'll find Chevrolet has thought of it first, and done most about it. Whether you get a handsome Fleetside or handy Stepside model (or possibly a Corvair 95 Rampside or Loadside or one of a half-dozen four-wheel-drives) you'll soon be convinced that buying a Chevy pickup was the best idea you ever had!



ECONOMY

The Chevrolet slant on economy makes the most sense of all, with the tight-fisted 235-cubic-inch Thriftmaster 6 (standard) leading the way. It's the most experienced money-saver going, one that's powered more payloads than any other engine in the business. It's famous for its stingy way with a gallon of gas and also for its rock-ribbed durability. It keeps your Chevy at work, making money, instead of in the repair shop, costing. And if you prefer the extra snap of V8 power, there's the eager, efficient Trademaster V8, 160-horsepower strong and available at nominal extra cost in all conventional pickup models.



CAPACITY

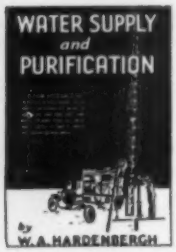
Chevy pickup bodies—6½, 8 or 9 feet long—are tops in cargo capacity and convenience, with a long list of bonus-built features to keep them working better and looking their best from delivery to trade-in. Both Fleetside and Stepside models feature select wood floors for better footing and quieter going, with steel skid strips to ease loading and unloading. Extra strong grain-tight tailgates with anti-rattle latches and support chains minimize bulk cargo leakage and offer firm support for extra-long loads. Fleetside body sidewalls are double-walled in the lower section, for extra rigidity and protection of exterior surfaces against dents caused by shifting cargo.

PROFIT-★★★★★-PROTECTING RIDE

All of Chevrolet's 2-wheel-drive pickups feature years-ahead Independent Front Suspension design, with ride, roadability and ruggedness that are paying off for truckers everywhere. The reduction in driving effort and fatigue that makes a bigger day's work come easy is just one part of the three-way Chevy payoff. The same shock-cushioning action protects your cargo against damage en route, and also protects the truck itself against the bumps that can batter the life out of cab, body and chassis components. Sounds too good? . . . sample it for yourself at your Chevy dealer's, soon! . . . Chevrolet Division of General Motors, Detroit 2, Mich.

1961 CHEVROLET STURDI-BILT TRUCKS CHEVROLET

Books and Reprints For Your Engineering Library



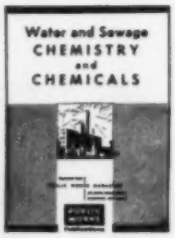
Water Supply and Purification

By W. A. Hardenbergh

Among the major changes introduced in this latest edition are the following: The chapters on ground water, on filtration, and on laying pipe and maintaining lines have been almost completely rewritten; the chapters on pipe conduits and on disinfection have been revised to bring the material in them up-to-date; and a new chapter has been added on fluoridation. Design examples of all kinds are worked out in detail to illustrate practical, up-to-date methods. To order your copy circle C-1 on the coupon.

$7.25 **C-1**

Water and Sewage Chemistry and Chemicals



If you are not an expert chemist but want a dependable text on chemistry as applied to sewerage and water works—send for this valuable reprint today. Written in plain language so anyone can understand it. Four color illustrations are used to show the exact nature of colorimetric reaction in some specific laboratory tests—something that is possible only with this type of work. Of special interest to water or sewage plant operators. To order your copy just circle number C-2 on the handy coupon.

$1.00 **C-2**

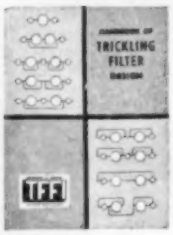
Principles of Soil Engineering

By Robert F. Baker

A knowledge of soils and soil engineering is important for all who deal with earth for engineering problems. Rarely is a structural design evaluated without recognition of the soil characteristics affecting foundation requirements. Without attempting to develop detailed concepts and procedures, Professor Baker has presented a comprehensive discussion of the subject of soil behavior in terms of basic principles. To order your copy of this informative 40 page booklet just circle number C-3.

$1.00 **C-3**

Handbook of Trickling Filter Design



This is the fourth edition of this informative and valuable 38 page Handbook. It has been completely revised, rewritten and brought up to date. Among the many subjects included are General Design, Media, Drainage and Ventilation, The Aerofilter: Description and Design Data, Standard Rate Filters, General Design for High Rate Filters, The Biofiltration System, The Accelo-Filter System of Wastes Treatment, A Nomographic Solution for Trickling Filter Design. Just circle number C-4 on the coupon.

$1.00 **C-4**

The Design of Small Water Systems

By Joseph A. Salvato, Jr., P.E.

Water systems to serve small communities, institutions, camps, turnpike service areas and isolated commercial establishments present special problems for the designer. In this excellent 28 page reprint the author considers design standards, equipment, filtration, sources and treatment, quality problems, pumping distribution, coagulation and settling, operation control, storage and related factors for systems capable of supplying 15,000 to 200,000 gallons per day. Just circle number C-5 for your copy.

$1.00 **C-5**

Sewerage and Sewage Treatment

By W. A. Hardenbergh

An authoritative yet simple treatment of the subject by one of the nation's foremost authorities. Mr. Hardenbergh's editorial and field work has brought him in close contact with the problems that trouble the average engineer and in this book he explains those methods most suitable for general use. Special attention is paid to sewerage systems, both storm and sanitary. Design examples of all kinds are worked out in detail to illustrate practical, up-to-date methods. To order your copy circle C-6 on the coupon.

$7.25 **C-6**

The Operation of Sewage Treatment Plants

This valuable text has been completely revised, expanded and brought up to date. In it all phases of Sewage Treatment Plant operation are treated in simple, easily understandable language. Among the many subjects covered are: measurement flow; concentration and temperature; sampling sewage for analysis; laboratory determinations; purposes of treatment; operation of grit chambers; operation of screens; trickling filter operation; filter fly control; disposal of sludge; etc. Circle C-7 for your copy.

$1.00 **C-7**

The Operation of Water Treatment Plants

Here in one place you have the basic information concerning all phases of plant operation. Even those without previous technical school education will find it easy to learn from this valuable text. Completely revised, expanded and brought up to date by Clayton H. Billings, Associate Editor of Public Works. This reprint is of special interest to Water Works Superintendents, Water Treatment Plant Operators and everyone connected with the Water Works field. To order your copy circle C-8 on the coupon.

$1.00 **C-8**

PUBLIC WORKS Magazine
200 So. Broad St., Ridgewood, N. J.

C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8
($7.25)	($1.00)	($1.00)	($1.00)	($1.00)	($7.25)	($1.00)	($1.00)

I enclose $.....for which please send me postpaid the books I have circled above.
I understand I may return any of them within ten days for full refund if not satisfied.

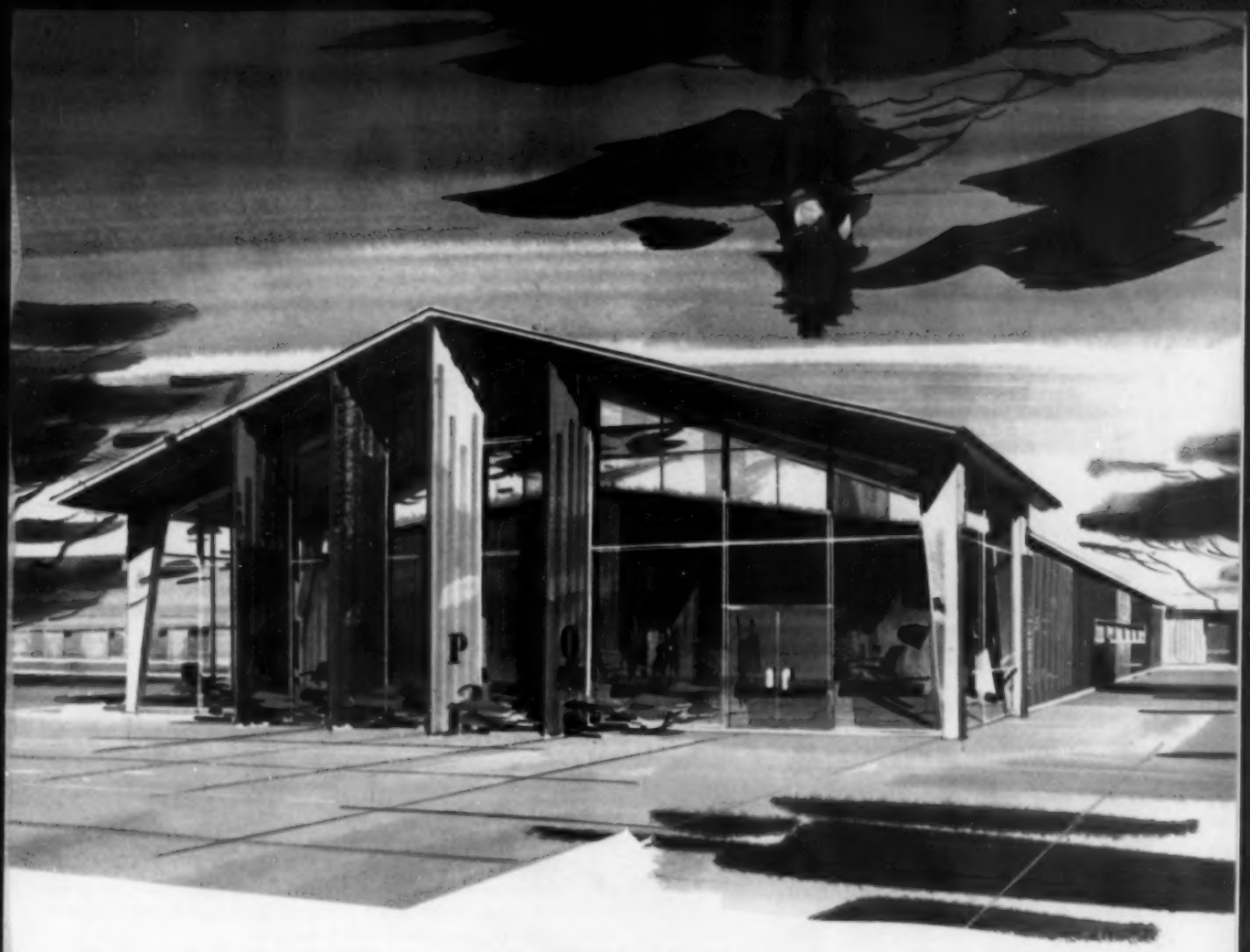
Name .....

Title .....

Address .....

City ..... Zone ..... State .....

PUBLIC WORKS
Publications



Handsome is and handsome does

...colorful Butler Buildings are functional too!

It's no accident that Butler buildings are finished with the most striking *and* protective color offered in the industry – Butler-Tone™. Butler alone uses America's number one system of pre-coating metal panels. Butler-Tone coats both sides. Butler-Tone adds extra years of new-looking color and time-defying protection. Maintenance costs are minimized.

Add Butler-Tone to the industry's two outstanding wall systems, optional roof guarantee, widest range of clear-span sizes and types – and you have America's number one pre-engineered building value.

Phone your Butler Builder for the full story. He's in the Yellow Pages under "Buildings" or "Steel Buildings." Ask about financing, too. Or write direct.

TURN THE PAGE TO SEE WHAT COLORFUL BUTLER BUILDINGS WILL DO FOR YOU...

CELEBRATING 60 YEARS
BUTLER
FABRICATING METALS

Coast to Coast

...industry finds advantages in

BUTLER BUILDINGS

Flick-Reedy Manufacturing Corporation, Bensenville, Illinois, winner of Factory Magazine's 1960 "Plant of the Year" award. ARCHITECT: *Zay Smith & Associates, La Grange, Ill.,* DESIGNER: *Norman Steenhof.*

Manufacturing . . . warehousing . . . distribution, industry finds that the Butler Building System suits all three functions.

. . . like floor space. Clear-spans bridge areas up to 120 feet.

. . . like overhead space. Rigid frame design provides space for lights, craneways, other fixtures. Raw and finished inventories stack to maximum pallet heights.

. . . like expandability. Adding to a Butler is easy, fast, economical . . . with practically full salvage of original materials.

No, there's nothing nebulous about the advantages our customers associate with Butler industrial buildings. Your Butler Builder (see "Buildings" or "Steel Buildings" in the Yellow Pages) will be happy to discuss other advantages, including financing. Call him . . . or write direct.

Southwestern Plastics, Houston, Texas

"See Sweet's Industrial or Architectural File—Section 8-B"

MBMA

CELEBRATING 60 YEARS FABRICATING METALS

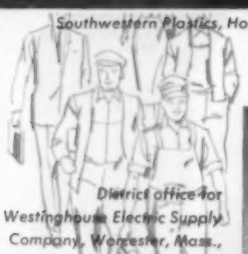
BUTLER

BUTLER MANUFACTURING COMPANY

7375 EAST 13th STREET, KANSAS CITY 26, MISSOURI

Manufacturers of Metal Buildings • Plastic Panels • Equipment for Farming, Transportation, Bulk Storage, Outdoor Advertising • Contract Manufacturing

Sales offices in Los Angeles and Richmond, Calif. • Houston, Tex. • Birmingham, Ala. • Kansas City, Mo. • Minneapolis, Minn. • Chicago, Ill. • Detroit, Mich. • Cleveland, Ohio • New York City and Syracuse, N. Y. • Washington, D. C. • Burlington, Ontario, Canada



District office for Westinghouse Electric Supply Company, Worcester, Mass., one of six Butler buildings recently completed for The Westinghouse Electric Supply Company throughout the country.

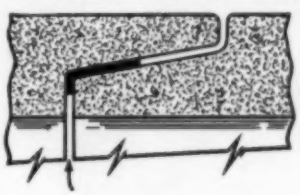
There's a quick-coupling, leak-proof, acid-resistant

TYLOX® *flexible* GASKET

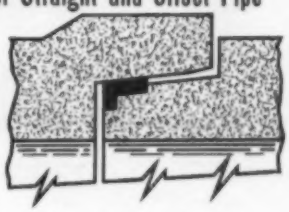
for any type of concrete pipe sewer line you plan or build

Are your files up to date on the *full line* of Hamilton Kent TYLOX Gaskets? Whether you are planning lines using T & G, B & S, Offset or Recessed Pipe, there's a special TYLOX true compression Gasket, in either rubber or neoprene, to assure fast pipe-laying and make the joints water-tight and acid-resistant for the life of the pipe itself. Check this list, and write for the TYLOX Data Brochures needed to make your reference files complete:

TYPE "C" and "C-P" TYLOX for Straight and Offset Pipe

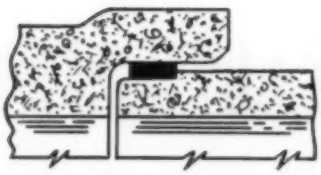


Type "C" Tylox under full compression. Note the visual inspection feature.



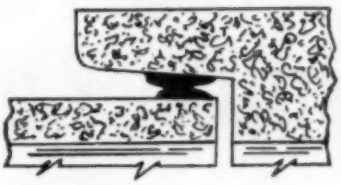
Type "C-P" Tylox under full compression. Flanges "lock" Gasket in proper position on the pipe offset.

TYPE "CR" TYLOX For Offset Pipe



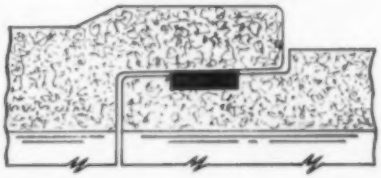
Type "CR" Tylox under full compression on single offset pipe.

TYPE "K" REXON for all types of B & S Pipe



Rexon "K" under full compression. Types available for both heavy and light duty service.

TYPE "CR" TYLOX (for Recessed Pipe)



Tylox Type "CR" under full compression. Wide, flat design makes "CR" roll and twist-proof.

USE THIS COUPON TO WRITE FOR MORE INFORMATION ▼

5152-3A

HAMILTON KENT MANUFACTURING COMPANY
KENT, OHIO
427 West Grant St. ORchard 3-9555

Please send data brochures on the following Tylox Gaskets:
Type "A" ☐ Type "C and C-P" ☐ Type "K" Rexon ☐
Type "CR" ☐

Name_____
Firm_____
Position_____
Address_____
City_____ Zone____ State_____

NORTHWEST: Seattle 1, Wash., MUtual 2-7667 • CANADA: Cooksville, Ont., ATwater 9-3671

SIX-INCH LOK-COR for the Tech installation was laid out in a herringbone pattern with perforated laterals leading into non-perforated mains. LOK-COR's exclusive Double Lock Seam will not unravel or become disconnected, even under shifting loads, or severe freezing and thawing conditions.

LOK-COR Performance Report: **CARNEGIE TECH**

SUBDRAINAGE INSTALLATION TIME CUT 25%

CARNEGIE INSTITUTE OF TECHNOLOGY—NOVEMBER, 1960. The speed and ease with which Republic LOK-COR Subdrainage Pipe can be installed, and LOK-COR's effectiveness for removing subsurface water were proved in Tech's new athletic field. The contractor advises that 25% was trimmed off time and labor costs with LOK-COR.

Site planner and landscape architect on the job was Griswold, Winters, and Swain, Pittsburgh. Mr. William Swain, partner in the firm, states, "*A six man crew put in approximately 800 feet of pipe a day . . . installed the complete subdrainage system in just eight working days. Fittings, clamps, and pipe were easily and rapidly joined.*"

"*I inspected the pipe upon delivery . . . found the coatings unusually uniform and sound. The 20′ lengths of LOK-COR made it easier to establish correct slopes as the pipe was installed.*"

FIELD WAS IN TOP PLAYING CONDITION just six weeks after sodding. The installation of Republic LOK-COR was completed August 15, 1960. Sodding was completed September 9th, and the first football game was played on October 22nd. Mr. Swain checked the field after each game and reports, "*Subdrains are functioning very well. Three games have been played on the new sod to date, with no more damage than is expected on established turf. One game was played during the end of a three day rain.*"

To better meet subdrainage requirements on your current and future projects, get complete information on Republic LOK-COR, the new standard in corrugated subdrainage pipe. Send the attached coupon or contact your nearest Republic Drainage Products Distributor.

ONE OF LOK-COR'S MANY TIME- AND MONEY-SAVING FEATURES is that LOK-COR can be installed in a much narrower trench than other types of subdrainage pipe, which require that connections be made in the excavation. At Carnegie Tech the complete LOK-COR subdrainage system was assembled on temporary supports at ground level, then lowered into trenches progressively as wooden supports were removed.

POSITIVE BOND AND ANCHORING, assure support for heavy weight. Truscon Re-Bars form backbones of steel in reinforcing modern highways, concrete slabs, footings, walls, beams, and columns. Truscon uses only new billet steel in Truscon Re-Bars to maintain highest quality standards. Fabricating facilities are located in major building areas to assure on-time deliveries. Shipments are bundled and tagged for quick on-the-job identification and placing.

QUICK, TROUBLE-FREE PERFORMANCE is yours when you use Republic Flexible Plastic Pipe to bring in construction water . . . or drain flooded excavations. Made of tough polyethylene, it resists abrasion and the effects of acids and alkalies. In addition, it is immune to electrolytic action. Lightweight and easy to cut or join, it can be used on job after job.

REPUBLIC STEEL

Republic Has the Feel for Modern Steel

Strong,
Modern,
Dependable

LIFT-SLAB CONSTRUCTION using columns of 10¾-inch O.D. Republic Steel Pipe, helped provide low-cost erection of this Cleveland, Ohio, building. Slabs were poured on ground, then gradually hoisted up the steel pipe columns by means of hydraulic screw jacks. Scaffolding and elevators were eliminated. Mail coupon for details on Republic Steel Pipe.

REPUBLIC STEEL CORPORATION

DEPT. PK-2128

1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO

Please send information on:

☐ LOK-COR Subdrainage Pipe
☐ Truscon Reinforcing Bars
☐ Steel Pipe
☐ Flexible Plastic Pipe

Name_____ Title_____

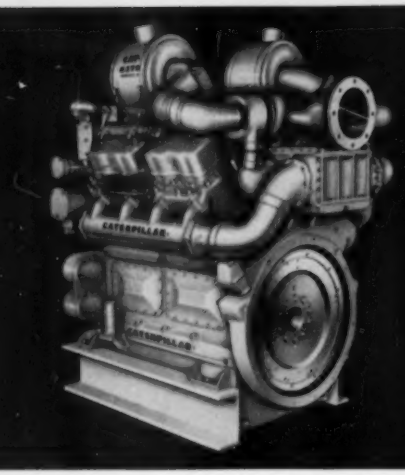
Firm_____

Address_____

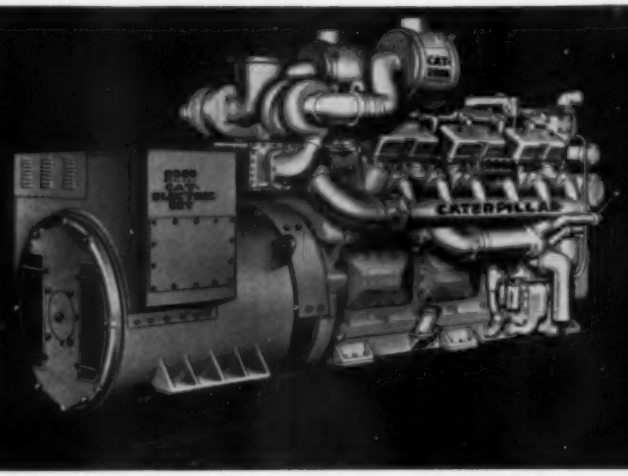
City_____ Zone_____ State_____

engine power BY CATERPILLAR

new Cat D398-D379



Cat D379 Industrial Engine. The 6.25" bore, 8.00" stroke D379 and D398 both offer the latest in attachments including marine gears and generators. The D379 Electric Set develops up to 350 KW continuous, 400 KW standby.



Cat D398 Electric Set. The D398 Electric Set shown here with Static-Regulated, Static-Excited Generator features a new generator with built-in static excitation system with no exciter generator or vibrating parts. Develops 500 KW continuous, 600 KW standby.

Give more horsepower per pound, per dollar than any other industrial engine in their class

The V12 D398 and the V8 D379 are rated at 950 and 630 maximum HP, respectively. Electric set versions reach to 600 and 400 KW. Marine ratings exceed 1000 HP. These engines are now available at prices that are less than crankshaft replacement prices of some competitive engines in their class.

Published list prices show the D398 to be thousands of dollars less than the next lowest priced industrial engine that will develop comparable horsepower. Other advantages are quality aluminum alloy bearings, aluminum pistons with cast-iron ring band for top two compression rings, drop forged-dynamically balanced crankshaft and high strength rigid block. These engines save in space and weight, too . . . with at least 35-40% less size and 4800 pounds less weight than other makes with comparable horsepower.

Here are more reasons why Cat D398 and D379 Diesels and Electric Sets give you extra value

NEW PERFORMANCE STANDARDS

- Turbocharged-Aftercooled design
- Static-Regulated, Static-Excited Cat Generators
- High flow lube and water systems
- Ability to burn wide range of fuels

NEW ENGINE FLEXIBILITY

- 100% HP from either end of engines
- Six available accessory drives – up to 50 HP each
- Controls available for either side
- Standard (counterclockwise) rotation or opposite rotation

NEW SERVICE EASE

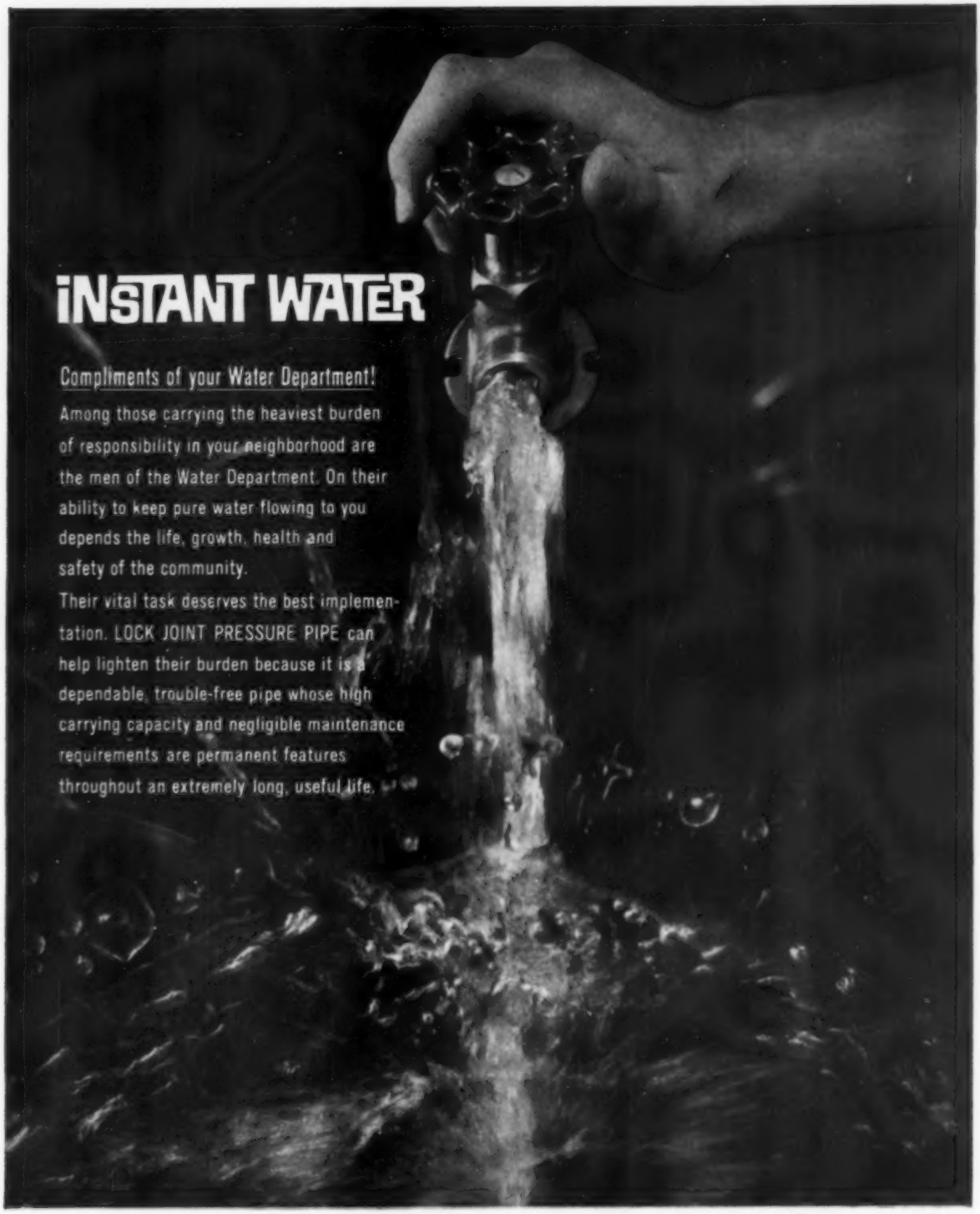
- Fuel or lube filters serviced from either side
- Remove heads without disturbing manifolding
- Easily inspect or remove pistons, rods and bearings through large side ports
- Externally mounted oil pumps for easy inspection and maintenance

For complete specifications on the D398 and D379 Diesel Engines or Electric Sets, contact your Caterpillar Dealer or Caterpillar Engine Division, Peoria, Illinois.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Caterpillar Tractor Co., Engine Division, Peoria, Illinois, U. S. A.


INSTANT WATER
Compliments of your Water Department!
Among those carrying the heaviest burden of responsibility in your neighborhood are the men of the Water Department. On their ability to keep pure water flowing to you depends the life, growth, health and safety of the community.
Their vital task deserves the best implementation. LOCK JOINT PRESSURE PIPE can help lighten their burden because it is a dependable, trouble-free pipe whose high carrying capacity and negligible maintenance requirements are permanent features throughout an extremely long, useful life.

LOCK JOINT PIPE CO.

East Orange, New Jersey

Member of The American Concrete Pipe Association and The American Concrete Pressure Pipe Association

Sales Office: Chicago, Ill. · Columbia, S. C. · Denver, Col. · Detroit, Mich. · Hartford, Conn. · Kansas City, Kan. · Perryman, Md. · St. Paul, Minn. · Winter Park, Fla.

Pressure • Water • Sewer • **REINFORCED CONCRETE PIPE** • Culvert • Subaqueous

Municipal Power

PREPARATION OF ELECTRIC SYSTEM OPERATING BUDGETS

BRUCE J. ENNIS
Associate,
Burns & McDonnell Engineering Co.,
Kansas City, Missouri

OPERATING BUDGETS are necessary for good management of an electric utility. They provide the guide posts by which the business policies may be directed, the standards by which the condition and performance of the system may be measured, and the bases for formulation of a master plan for future operations. Approval of an annual budget for the ensuing year by the public utility board of directors or city council provides the authorization for management to proceed with the plans of operation contained in the budget.

When compared with past operations, a carefully prepared and comprehensive operating budget for the coming year will indicate necessary or desired changes in operating and financial policies in keeping with prudent management of the business. Such comparisons should be made to the many items of operation for the past three to five years, in order to determine future estimates with a reasonable degree of accuracy.

Just as no two utilities are identical in the size and scope of their operations, so will their operating budget requirements and format vary widely among individual systems. If a distribution system depends solely on purchased power for its prime supply of electricity, items of expense associated with the production of power in a steam, diesel, or hydro plant will not have been contained in its operating budget. Rural systems, with preponderantly domestic energy consumption supplied through widely scattered substations or metering points, encounter problems basically different from those which will need to be planned for in the annual operating budget of an urban system serving a much higher percentage of commercial and industrial loads in a relatively compact service area.

Conversely, many items in an operating budget are universal in nature, regardless of the type of electric utility for which it is to be prepared. Such items include estimates of future loads and revenues, administrative and general expenses, depreciation, taxes, interest, operation and maintenance expenses for the distribution system, and the like. Detailed descriptions of these, and other related items of revenues and expenses to be included in an annual operating budget, are contained in the Uniform System of Accounts published by the Federal Power Commission. In general, an operating budget should include estimates for the next year's operations for major items such as the following:

Estimates of Loads

By reference to the past trends of load growth among the residential, commercial, industrial, and other consumer classifications, estimates may be prepared of future loads, taking into account additional loads from probably new consumers which may be added during the year. Annual kilowatt-hour sales are determined by the multiplication of the estimated annual consumption per consumer by the estimated number of consumers in each classification. The required gross energy input to the system is estimated by adding normal system line losses and station usage to the annual energy sales. Since load estimates are used to determine revenues and production (or purchased power) expenses, they should be made on a monthly basis to allow for seasonal variations, and the system's demand and energy requirements should be broken down in separate schedules.

Estimates of Revenues

Applying the rate structure of the various classifications to the demand and energy load requirements, it is possible to estimate the annual revenues which may be anticipated from the sales of electric energy. Such revenues should include sales to other utilities, rent from electric property, income from consumers' forfeited discounts and penalties, and miscellaneous electric revenues.

Estimate of Energy Generated Purchased, or Interchanged

Based on the load estimates of total system input requirements, it is necessary to plan for the most economical method for supplying these requirements from existing or newly contemplated power sources. Such plans should include studies of production costs, purchased power costs, relative plant efficiencies, and capability of facilities to determine desired power and energy requirements from each of the one or more power supply sources.

Estimates of Costs

The estimated cost of delivering power to the system's consumers should be determined in a manner such as the following:

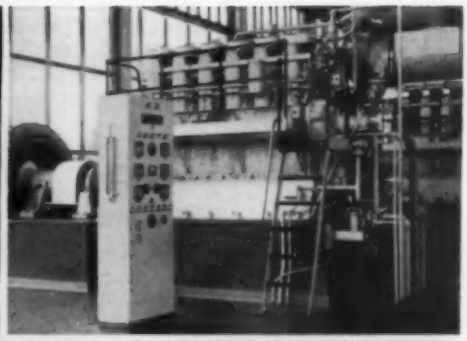
Production Expense: 1) Station Labor: This item includes the salaries and wages of operating personnel, including supervision and engineering; boiler labor; prime mover, generator and electric labor; and miscellaneous station labor, taking into account wage increases contemplated for the ensuing year, and excluding any labor properly chargeable to construction work.

2) Fuel: Based on the system's gross energy input requirements from the power plant, with known and estimated station heat rates and fuel costs, the annual fuel expense may be calculated. Similar determinations should be made also for the cost of lubricants, especially for diesel or gas engine power plants. In case an increase in price is contemplated for prime fossil fuels, the estimates should, of course, include the higher price anticipated.

3) Water: This item should include the cost of water for boiler make-up and for cooling water for surface condenser or engine jackets.

4) Station Supplies and Expenses: Items under this group include boiler inspection fees, log sheets and charts, tools, stationery, etc. Although they do not vary appreciably from year to year, additional amounts should be included for the next year's operating budget for items in which changes are anticipated from the preceding budget.

TOLEDO SEWAGE PLANT
Handles up to 135 Million Gals. per day

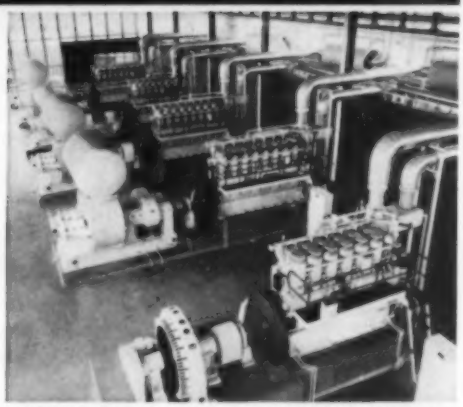


with ENTERPRISE Tri-fuel Engines

Design and Construction by Consoer, Townsend & Associates, Chicago.

Main sources of power and processed air in the modern, highly efficient Sewage Plant of the City of Toledo, Ohio are five Enterprise turbo-charged, tri-fuel engines. These versatile heavy duty engines operate on diesel fuel, dual fuel, or spark ignition. The switch from straight diesel fuel to pilot-injection sewage gas operation is instantly accomplished by means of a lever control mounted on front of the engines. To switch to spark-ignition sewage gas operation requires only a minor change, in just a few hours' time. Annual savings through the use of sludge gas are estimated at around $50,000. Heat normally required for the plant and processes is provided from jacket water and waste heat mufflers with the engines in operation.

For low-cost, dependable power on municipal and industrial jobs, your next engines should be ENTERPRISE. Call us, or write for complete data and recommendations.



BOTTOM, Four Enterprise engines drive blowers for aeration process.

TOP, Fifth Enterprise engine drives a generator for stand-by power.

ENTERPRISE Diesels

THE DEPENDABLE

A SUBSIDIARY OF TRANSAMERICA CORPORATION

Enterprise Engine & Machinery Co., Division of General Metals Corporation
550-85th Ave., Oakland 21, Calif. • 37-02 48th Ave., Long Island City 1, N.Y.
National and worldwide sales and service

5) Maintenance: Maintenance labor expense should be estimated in a manner similar to station labor, taking into consideration planned unit overhauling schedules for the determination of probable costs.

6) Purchased Power: Applying the power suppliers' rate schedule to estimates of gross system purchases of power and energy from other utilities, the cost of purchased power may be estimated.

Distribution Expenses: 1) Labor: This item may be estimated by applying wage scales to the list of operating personnel engaged in supervision, engineering, load dispatching, substation labor, overhead and underground lines, tree trimming, street lighting, and other operating functions, including the effect of probable wage increases, but excluding the cost of labor used for new construction work.

2) Maintenance: In a similar manner, the cost of maintenance labor should be estimated by comparison with past years' expenses, taking into account the line and substation material costs based on miles and KVA, respectively. An allowance should be included for additional maintenance costs as the age of the system increases.

Customer Accounting and Collecting: Items in this group include supervision, meter reading, billing, accounting and collecting, uncollectible accounts and related expenses.

Sales Promotion Expense: From previous years' experience, the cost may be estimated for sales promotion personnel salaries, including demonstrations, advertising, and other sales expenses. Unless a change in policy is contemplated, these expenses will not vary greatly from year to year.

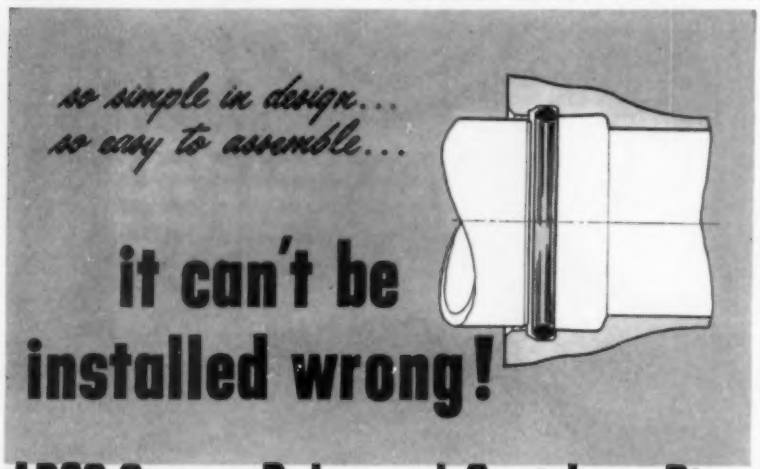
Administrative and General Expenses: Items for which estimated annual expenses are required in this group include salaries of general office employees, the cost of office supplies, legal expense, insurance, welfare and pension expenses, the cost of injuries and damages, the maintenance of office buildings, and other general property, etc. In general, as the value of the total system property increases from year to year, so will the amount required for protective insurance premiums increase.

Depreciation and Interest: Estimates of the amounts to be set aside for depreciation of plant and equipment will vary in accordance with the value and expected useful life of the various items of property, taking into account the value of property to be added to, or removed from the system during the ensuing year. The amount to be set aside for interest payments will be based on the schedule of debt service requirements.

Taxes: The amount to be charged to taxes, or to payments in lieu of taxes, will depend on the stipulations of the city charter, on the value of the property and the tax rate, or similar requirements peculiar to the individual system.

After the above estimates of expense have been made, they may be summarized into a consolidated operating budget for the ensuing year; in which net operating revenue will be shown as the difference between annual revenues and the operating expenses and other deductions.

The net revenue estimated for the next year's operations, when compared with the trend of corresponding figures from past years' operations, will indicate whether or not a closer scrutiny is warranted of the individual items in the budget to determine the basis for abnormal variations from past trends, and the steps to be taken to establish a sound operating budget.



APCO Super-DeLavaud Cast Iron Pipe

with the famous ALTITE JOINT

Underwriters Approved — Protected by Patent

Insert rubber gasket in bell end of pipe. You can't put it in wrong.

Lubricate lightly to reduce friction.

Insert plain beveled end — there are no grooves, ridges, or tips on gasket to interfere.

Small amount of pressure forces end to bottom of socket, completing the tight joint.

Requires only one accessory — a reversible rubber gasket as shown above. Assembly is quickly made — even by inexperienced crews.

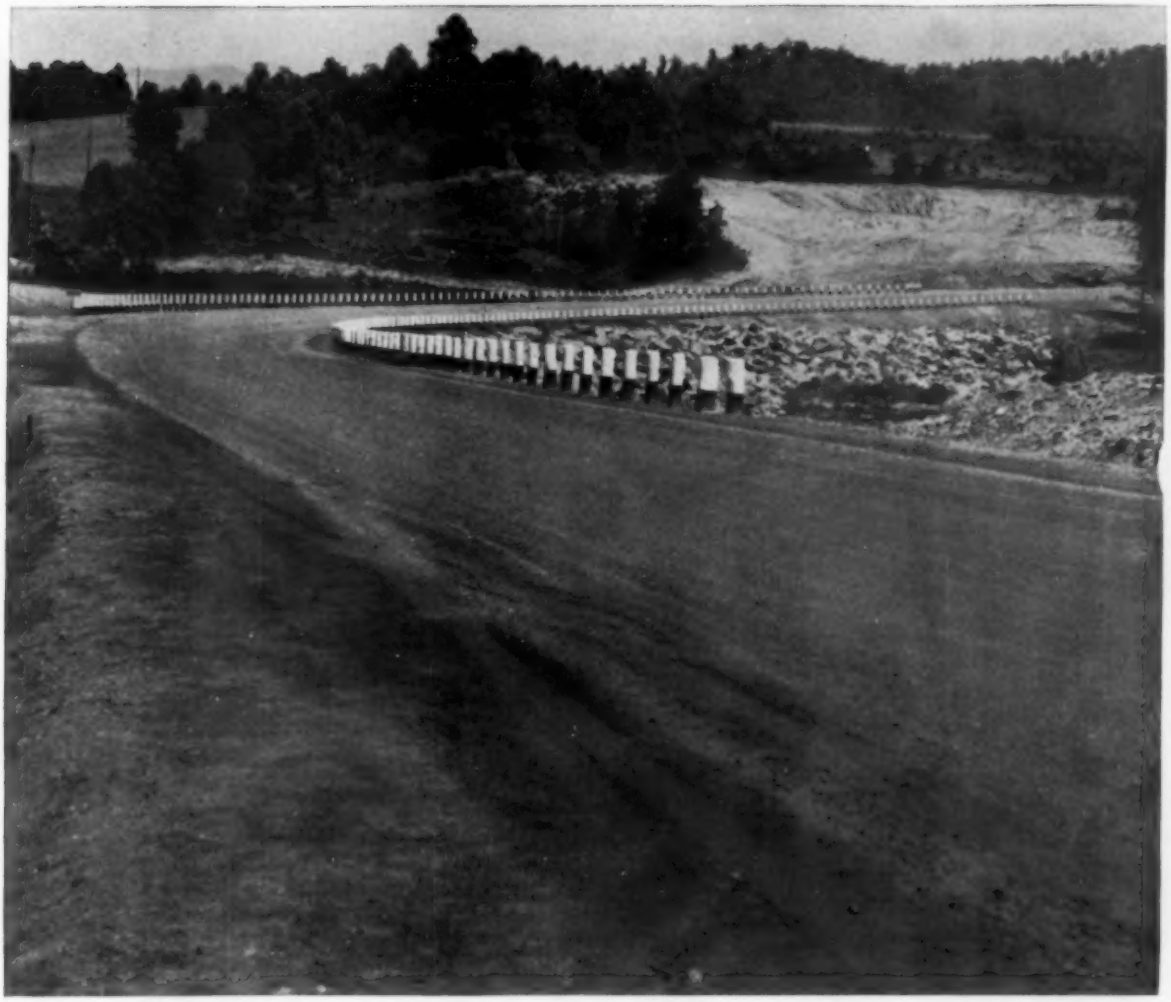
Inside contour of the bell provides seat for holding the gasket firmly in place. Plain end of pipe is furnished with a bevel to aid in sliding into gasket.

Underwriters Laboratory approved, the APCO ALTITE JOINT is the answer to savings in installation costs... and savings in time.

Write for your copy of Catalog No. 54

ALABAMA PIPE COMPANY
A Division of Woodward Iron Company
ANNISTON, ALABAMA · Phone ADams 6-7601

5335 Southern Ave., South Gate, Calif.
CHICAGO: 122 S. Michigan Ave. KANSAS CITY: Suite 950, 1006 Grand Ave.
NEW YORK: 350 Fifth Avenue DETROIT: 18505 W. Eight Mile Road



ride now . . . pave later

Stage construction with COLUMBIA Calcium Chloride improves your roads, pleases residents, stretches budgets

Keep more of the residents in your area satisfied at the same time you stay within the budget, by planning ahead on secondary roads. A new program of stage construction built around the proved moisture retention, dust control and stabilization power of COLUMBIA Calcium Chloride offers you these benefits:

1. IMPROVED RIDING ON MORE MILES OF ROADS. By stabilizing and compacting properly shaped secondary roads, you can offer safe, dust-free driving now, even though you can only afford to pave a small percentage of your roads. "Thirsty" Columbia Calcium Chloride turns the trick.

2. IMPROVED BASE FOR FUTURE HARD PAVING. Because COLUMBIA Calcium Chloride saves aggregate and holds fines moist, little or no further preparation is needed when your budget *does* permit final paving. The stabilized base means longer life for the up-graded surface, too.

Helpful information on the new balanced program of secondary road improvement is available from the makers of COLUMBIA Calcium Chloride. Just use the coupon.

columbia | southern chemicals
CHEMICAL DIVISION
PITTSBURGH PLATE GLASS COMPANY
ONE GATEWAY CENTER PITTSBURGH 22, PENNSYLVANIA
DISTRICT OFFICES: Boston • Charlotte • Chicago • Cincinnati • Cleveland Dallas • Houston • Minneapolis • New Orleans • New York • Philadelphia Pittsburgh • San Francisco • St. Louis • IN CANADA: Standard Chemical Limited

Columbia Calcium Chloride
One Gateway Center
Pittsburgh 22, Pa.

Please send me a copy of "A Program for PROGRESSIVE IMPROVEMENT of Secondary Roads."

Name_____

Title_____ Organization_____

Address_____

City_____ Zone____ State____

1

City of Binghamton sees clear water ahead for a full generation

Westinghouse Powers-Up New Filtration Plant to Meet Rising Demands of Next 30 Years

Present population: 85,000—growth reaching at least 105,000 by 1975. This is the future for Binghamton, booming city in upstate New York. With this fact in mind, planning of their new 4,000,000-dollar filtration plant accented expandability for rapidly increasing water demands to 1990.

Westinghouse has provided a power distribution system that will assure this objective. With present pumps and treating equipment, total capacity is 31,000,000 gallons per day. Plant capacity can be expanded 50% during the 30-year period without additional substation, bus or switchgear equipment. Beyond basic flexibility, the electrical equipment will be called upon for absolute, 24-hour reliability for this projected long life span. Westinghouse power components are coordinated to work together, and will fulfill this objective also . . . dependability, with minimum servicing or maintenance.

For look-ahead electrical planning and products to match, call your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa.

You can be sure . . . if it's Westinghouse.

Westinghouse

J-94152-2

2

3

4

5

1. The Susquehanna gives up its water . . . Pipe gallery located under the filter operating floor houses raw water, backwash and waste water lines, control piping and valves.

2. Strength, beauty and simple utility . . . Plant exterior is finished in blue glazed brick, yellow porcelain enameled steel panels, anodized aluminum trim.

3. Utilized plant control . . . Main distribution center for new plant provides power to motor and auxiliary feeder circuits. Fed by 4000-ampere ventilated low-impedance bus duct, board consists of (right to left) plant service transformer and power panels; 480-volt switchboard with incoming line and motor feeder breakers of reliable DB design; control panels including flow and pressure indicators, gauges and master indicating lights to show status of all plant operating equipment. Entire unit was assembled by Westinghouse and delivered complete and prewired for fast, easy installation.

4. Mr. G. E. Rickard, Water Superintendent, checks ammeter reading at incoming switchgear and master control board with Mr. R. C. McNamara, City Engineer, who supervised over-all construction project.

5. Dependable power for 30 years . . . G. E. Rickard and R. D. Batley, Westinghouse Sales Engineer, discuss one of three Westinghouse SL transformers in plant outdoor substation. Present bank capacity is 2500 kva—future uprating to 2875 kva is possible through provisions for addition of forced air cooling. Westinghouse transformers feature exclusive Insuldur® insulation and Hipersil® grain-oriented steel cores to give extended life and higher efficiency. This substation, furnished by Westinghouse, also includes: 15-kv, 600-ampere, 100,000-kva IC oil circuit breakers; Type V disconnect switches; Type S station service transformer; main low-voltage bus as well as the integrated steel structure.

6

7

8

9

10

J-94152-3

Filtration Plant Powers-Up for Next 30 Years
(cont'd)

OWNER: *City of Binghamton*
GENERAL CONTRACTOR: *Smith-Howard and Sprague, Binghamton, N. Y.*
ELECTRICAL CONTRACTOR: *Lord Electric Co., Inc., New York, N. Y.*
CONSULTING ENGINEERS: *Leonard S. Wegman Co., New York, N. Y.*
Alexander Potter Associates, New York, N. Y.
ELECTRICAL DISTRIBUTOR: *Westinghouse Electric Supply Co., Long Island City, N. Y.*

6. Compact, expandable motor control . . . These Westinghouse units, together with the lighting panelboard (door open), centralize control for all auxiliary equipment in the chemical building. Motor starters serve mixers, drives, pumps. Thirty-kva transformer, feeding panelboard, completes assembly. Blank sections, at left, permit future additions.

7. Control for added capacity . . . Starters for high lift pumps include two new Westinghouse reduced voltage autotransformer types to complement several starters moved from original plant. Control accessories were added to modernize these—thus providing an economical conversion to the new control scheme. Westinghouse starters were used to control new 600-hp high lift pump and 125-hp wash water pump.

8. Close cooperation among the consulting engineer, electrical contractor and Westinghouse makes it possible for Binghamton to provide for the future today. Seen at left: A. J. Juris and E. J. Young of Lord Electric Co.; E. Piller, Westinghouse Electric Supply Co.; P. J. Gallagher, Westinghouse; and J. J. Fenley of Lord.

9. Color and light welcome visitors . . . Lobby area is handsome with terrazzo flooring, marble paneling, mosaic tile stair wells. Westinghouse Mainliner fluorescent luminaries blend with building's structural elements. Average illumination intensity is 90 foot-candles.

10. Room for more . . . C. E. Ahern, filter operator, seen at Westinghouse NLAB lighting panelboard which contains normal and emergency breaker sections with spares for future circuits. Flush trim and special brass hinges harmonize with architectural detail of plant.

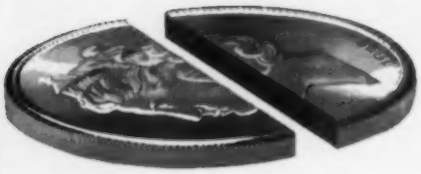
11. Take water, add chemicals, mix well . . . G. E. Rickard and R. D. Batley inspect the slow mix tanks. Settling tanks in background provide 3½-hour detention. Entire area is illuminated at night to promote safe operation and permit 24-hour observation of flocculation process.

J-94152-4

Westinghouse

NOW...

cut new filtration plant costs 45%



Increase clear water capacity 100%

Specify Celite diatomite filtration

You can now double the potable water capacity available to your growing community and cut the installation cost of new filtration nearly in half. How? Specify diatomite filtration. You'll reduce land and construction costs because diatomite systems need only ¼ the housing space of equivalent-capacity sand plants. In fact diatomite systems are so compact, they can sometimes be added to existing plants.

If you're considering water filtration for the first time, it makes good financial sense to go Celite* diatomite all the way. An actual test installation by Johns-Manville has proved that a diatomite filter station can be installed for 45% less than a sand filter station of equal capacity.†

What's more, Celite will usually give better water clarity under comparable conditions. Turbidity is far lower. More suspended solids, including all floc, amoebae and algae, are removed. And a Celite diatomite system is easily operated and maintained by regular municipal water personnel.

Mined from the world's purest commercially available deposit, Celite is carefully processed for complete uniformity. Call your nearby Celite engineer for complete information on Celite's wide range of grades; he will gladly assist with your particular problems. And write today for FREE informative reprint.† Johns-Manville, Box 14, New York 16, New York. In Canada, Port Credit, Ontario.

*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

†Comparison Studies of Diatomite and Sand Filtration by G. R. Bell, Journal American Water Works Association, September, 1950.

JOHNS-MANVILLE JM PRODUCTS

Brookfield, N.Y., finds Best Bid the best way to buy

"We buy machines as if we had to make a profit with them"

Mr. Lester D. Burch, Township Superintendent, Brookfield, New York: "Our community doesn't buy construction equipment very often. When we do, we need equipment that will give us the best possible performance—and do it at the lowest cost. That's why we look for *best bid* when we buy.

"No one knows more about *best bid* than a construction man who has to make money with his machines. And most contractors I know prefer to buy Caterpillar equipment. I figure what works for them will work for us.

"And it does. Take our new 93 HP D6B Tractor, for example. It has one feature alone that makes it worth a lot more to us than the other machines bid. This is the hydraulic tilt cylinder attachment. Our road work involves a lot of ditching. The tilt cylinder attachment lets the operator tilt the blade without leaving his seat. The amount of time this saves—and extra work it helps us get done—really adds up when you do a lot of ditching."

Mr. Burch mentioned another reason the town selected the D6. They needed a machine that would stay out of the shop—keep on the job. They liked the idea of the oil clutch that almost never needs attention . . . lifetime lubricated track rollers they could forget until rebuild time . . . the dry-type air cleaner that gets rid of the expense and mess of oil bath filter elements. All in all, the combination of extra performance, dependability and low-cost maintenance offered by this machine made *best bid* buying the town's best bet. Where it gives the private contractor a profit, it saves money for taxpayers.

Check the money-saving, time-saving features of Caterpillar-built machines when you need a tractor, loader, motor grader, engine or other earth-moving equipment. Your Cat Dealer can give you complete facts and a demonstration if you wish. And ask him about our new sanitary landfill movie: "A Decent Burial." He will be glad to arrange a showing.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U. S. A.

CATERPILLAR

Caterpillar and Cat are Registered Trademarks of Caterpillar Tractor Co.

Dependable Natural Gas Power...

A milestone in public education was reached this year as a Clearwater, Florida school experiment set out to compare air-conditioning operating costs and student achievements. Although building contracts for the new schools were comparable, the air-conditioned school, above, actually cost less to build because design was more compact, with reduced roof and corridor construction. At left, 7th grade science students stay cool and fresh, sustain interest throughout the day in climate controlled classroom.

Florida project relies on International engines to keep operating expense at reasonable level...

A new era for municipal air-conditioning may be the result of a school project getting underway in Clearwater, Florida. It is believed that climate control in the classroom will improve student comfort, promote alertness, reduce illness and absenteeism, and generally upgrade the education of our children. Although industry has universally accepted the merits of air-conditioning, school and municipal officials question its value when confronted with the cost and operating expense of reliable cooling equipment. The Clearwater project will answer this question.

The project began with construction of two junior high schools—the Oak Grove School in Clearwater and the Pinellas Park School in St. Petersburg—each one comparable in cost and capacity. The Clearwater school is air-conditioned, the other is not. Comparison of operating expenses and educational achievements in the two schools during the 1961-62 season will determine if climate control is worth the extra appropriation.

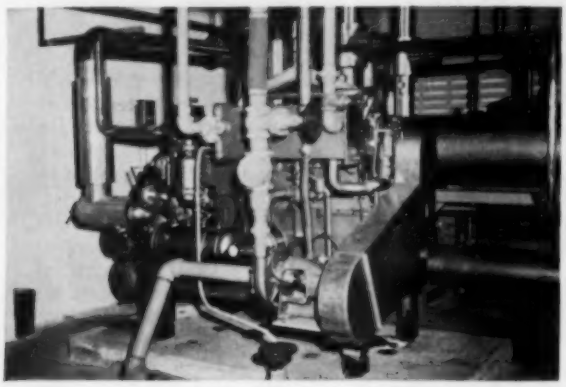
To keep operating costs at a minimum, school officials chose a natural-gas-powered system with outstanding characteristics of economy and efficiency —two Ready-Power 60-ton units driven by two International U-450 engines. The IH-powered system operates from 9:30 am to 4:30 pm, bringing classroom temperature to the desired level within 30 minutes. Water enters the line at approximately 90° F and leaves the system at 48° F. Return water is approximately 51° F. The separately-housed system keeps 24 classrooms and the gymnasium at about 72° F regardless of outside temperatures.

Clearwater officials join an ever-increasing number of public works experts when they turn to International as a single source of dependable, low-cost power. The wide range of sizes in the IH line—35 diesel and carbureted models from 16.8 to 385 max. hp—gives you job-matched power for all municipal needs. You can get complete information and installation assistance from your nearby International Engine Distributor or Dealer. Call him soon!

INTERNATIONAL®
ENGINES

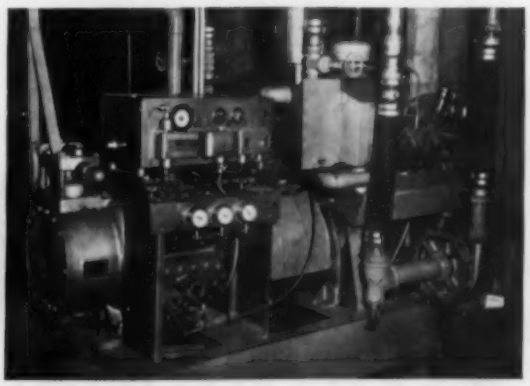
International Harvester Co.,
180 North Michigan Ave., Chicago 1, Illinois
A COMPLETE POWER PACKAGE

New Key to Low-Cost Municipal Air Conditioning



Officials who specified cooling equipment for the Clearwater project naturally turned to the most economical units they could find. Two natural-gas-powered International U-450 engines drive two Ready-Power water chillers in this low-cost system. Installations throughout the country indicate that International engines provide the most economical air-conditioning power available.

Operating Engineer J. E. Pratt controls temperature of each room and gymnasium from this master panel. Each classroom accommodates 35 students. The school began with 665 students, now has a total enrollment of 1,200. Provisions have been made for additional air-conditioning equipment as extra rooms are added to the present facility.



The City of Clearwater achieves further cooling economy with International powered units in other municipal buildings. One such installation is in the beautiful new Memorial Civic Center shown here. An International UV-549 V-8 engine powers a 72-ton Ready-Power unit with Trane compressor, to cool auditorium, public library and Chamber of Commerce offices. A similar low-cost International and Ready-Power installation air-conditions Clearwater's police department building and city jail.

the photoelectric lighting control that offers every industry need in one unit.

Lamplighter Series 15,000 is new. Already acceptance has been high. Why? Lamplighter is quality built, precision engineered to set a new standard in photoelectric lighting controls. While Lamplighter will actually cost you less, it offers every requirement for dependable, automatic street light operation. For example, Lamplighter's sensitivity adjustment, accessible from the outside, cuts replacement problems if you should raise light intensities in the future. Low turn-on, turn-off ratio keeps burning hours to strict minimum; superior surge and fuse protection help prevent damage in case of a short or overload. Linemen get protection, too, through plastic cover and base which provide high dielectric strength. A more-than-adequate time delay prevents turn-off from any intermittent lights. For easy adaptability, there's a complete line of accessories to meet many mounting requirements. *Write for detailed data.*

The Acme Wire Co.
Utility Products Division, Dept. MP-4
New Haven 14, Connecticut

LAMPLIGHTER

Ed Cleary Reports on:

Pollution Control Practice in Eastern Europe—Part I

EDWARD J. CLEARY
Diplomate, American Academy of Sanitary Engineering
Cincinnati, Ohio

"A number of water courses and lakes have become polluted owing to considerable increase in the volume of industrial and domestic wastes and to the fact that development of treatment systems has failed to keep pace with the rapid growth in industry and urban expansion. Water pollution causes serious concern because it limits the extent to which waters can be used in the national economy."

No, this is not another assessment of the situation in the U.S.A. This is a statement from Dr. T. Nagibina, chief inspector for the protection of waters in the USSR Ministry of Health, who recently surveyed the situation in Eastern Europe.

Dr. Nagibina was one of the delegates at the Feb. 22-Mar. 3, 1961, Geneva Conference on Water Pollution, sponsored by the Economic Commission for Europe. He had been invited to report on the organization and status of pollution-control practice in Russia and in other Eastern European countries, specifically Czechoslovakia, Poland, Bulgaria, Roumania and Hungary.

This report constituted one of the highlights of the conference, which was designed to promote an exchange of views on developments in both Western and Eastern European countries. Previous European seminars had dealt extensively with water pollution in Western countries. But not until the ECE conference last month did the opportunity present itself to receive a similar accounting for the Eastern countries. Dr. Nagibina's survey of practice must be regarded, therefore, as of significant interest in the U.S.A. as well as in Europe.

The first part of his report, dealing exclusively with the USSR, will be the subject of this commentary. A subsequent installment will be devoted to his assessment in five other eastern European countries.

Situation in the USSR

In describing affairs in the Soviet Union, Dr. Nagibina credited a May 17, 1937, decree "concerning the sanitary protection of water supply lines and sources of water supply" as one of the most important USSR legislative enactments. Under this decree, enterprises and establishments were without exception prohibited from discharging pathogenic or pollutional substances within a water supply protection zone and also throughout any built-up area.

He said this decree was extremely effective. But as a result of World War II, the measures provided could not be carried out in their entirety. And after the war the reconstruction of devastated towns and industrial enterprises, caused a considerable time-

. . . like a third hand for your operator
By maintaining the desired transverse slope automatically with Preco Dial-A-Slope, your LW grader operator can devote his entire attention, and both of his hands, to his other controls. Result? Easier operation . . . more production . . . and substantial saving in time and money on all your grading jobs.

LW graders with Dial-A-Slope blade control save you time, money

Where do you use a LeTourneau-Westinghouse grader equipped with Preco Dial-A-Slope automatic blade control? *Anywhere and everywhere!* It is effective on *every* phase of grading — from the roughest to the finest — with these particular benefits in finish grading:

Reduces grading time by 50%: A given grade can be completed in up to *half* the time it usually takes. In many cases, finish grade can be attained with *only one pass* — and is usually accepted on the first inspection without need for rework.

Accuracy of 1/10 of 1 percent: Dial-A-Slope electronically holds the blade *at the exact slope the operator has selected.* As he manually raises and lowers the toe of the blade to cut the longitudinal grade, the "automatic" end *instantly* follows his every move . . . maintaining the transverse slope to an accuracy of 1/10 of 1 percent.

Reduce staking costs: Your operator carries the slope across the *entire* width of the grade from *one* row of stakes. Intermediate rows of stakes (even on super-elevated curves) can be eliminated or reduced. Labor costs for auxiliary help, such as grade-checkers, are also reduced.

Save material: By insuring a smoother and more accurate finished surface, use of the Dial-A-Slope will result in more uniform thicknesses, hence substantial savings in costly imported base and/or paving materials. For example, a saving of just ¼-inch of thickness on one mile of minimum-width freeway amounts to a saving of 195 cubic yards of material.

Installed easily and quickly

Preco Dial-A-Slope can be installed on any new or used current-model LW grader . . . from the 85-hp "330" to the 190-hp POWER-*Flow*® 660. We will be happy to give you complete information and arrange for a demonstration.

You're invited to see new color film . . .

Feature: "Dial It"—the Automatic Blade Control.
Plot: How Dial-A-Slope thinks for itself.
Show time: At YOUR convenience.
Admission: FREE . . . for a showing, just call your LW Distributor.

G-2392-G-1

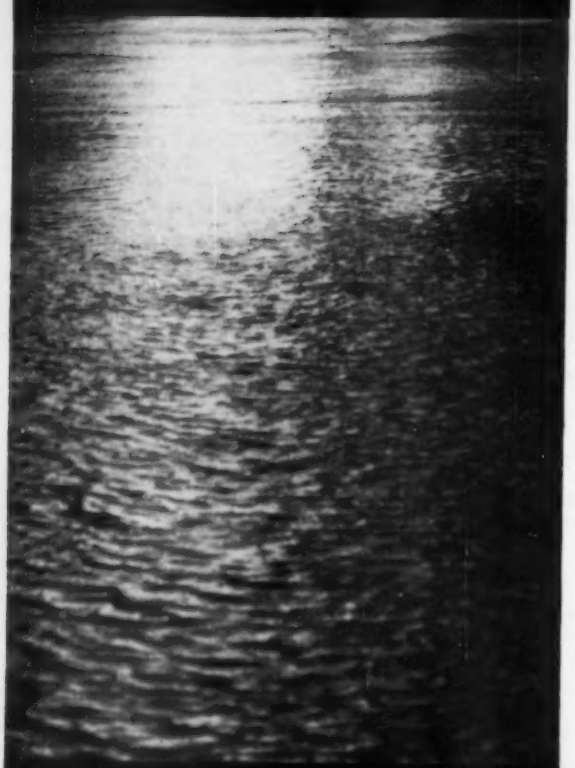
LETOURNEAU-WESTINGHOUSE COMPANY, PEORIA, ILLINOIS

A Subsidiary of Westinghouse Air Brake Company

Where quality is a habit

PURER WATER

Ferri-Floc
FERRIC SULFATE



We can help you with your water purification problems — coagulation, softening, removal of iron and manganese. We have reliable technicians ready to assist you in producing purer water. Let us send you complete information on Ferri-Floc.

SODIUM SILICOFLUORIDE
A white powder or granule (dyed blue if desired) for fluoridation of potable water.

TENNESSEE CORPORATION
612-629 Grant Building, Atlanta 3, Georgia

lag in the construction of sewage and industrial-waste control facilities.

Starting in 1947, additional legislative provisions have been promulgated to curb pollution from industrial wastes. These were designed to induce government and economic organizations to concentrate on the execution of programs to prevent the pollution of fishing waters and sources of water supply. Among other things, new industrial enterprises were not permitted to begin operations without first providing waste-treatment facilities. Regulations also were issued for the initiation of scientific research in this field.

Measures for water pollution control, said Dr. Nagibina, are carried out on the basis of national economic plans. Substantial sums of money are allocated for this purpose. During the current year, for example, it was said that the Russian Soviet Federative Socialist Republic alone appropriated roughly 800 million rubles.

Since 1937, industrial enterprises in the USSR that cause water pollution have been liable to a penalty, in the form of a fine, for the discharge of untreated waste water. On January 1, 1957, the penalty was increased by raising the amount of fine and making it chargeable to the production costs of the enterprise concerned. Dr. Nagibina reported that this fine is proving an effective weapon and to some extent, a stimulus for the execution of appropriate measures.

Public Health Requirements

The public-health authorities were for a long time solely responsible for initiating water-protection measures and for supervising all work in this field. Now the protection of waters from the point of view of fishing interests is in the hands of the authorities concerned with fisheries. These authorities establish their own standards. No waste discharges can be made without approval of both health and fisheries authorities.

The principal hygienic criterion for the harmfulness of waste discharges is the degree to which the use of water for domestic purposes is restricted as the result of pollution that creates quality deterioration or a hazard to public health. The underlying consideration is that changes in the composition and properties of the water caused by wastes do not in themselves determine the harmfulness of waste, but what is important is the extent to which the rivers and lakes become less usable for public supply purposes.

Hygienic standards for the protection of rivers and lakes are based on three indicators of harmfulness: (1) The effect on general sanitary conditions; (2) the effect on the organoleptic properties of the water (smell, taste, color) with regard to its use for potable supplies, sanitation and for cultural and welfare amenities; (3) the effect on the health of the population, as assessed by medical and toxicological criteria determined by tests on animals over prolonged periods of time.

In establishing hygienic standards, research is carried on in all three criteria of harmfulness; the standard is defined by reference to an indicator expressing the lowest concentration of the substance producing a harmful effect. Dr. Nagibina reported that "hygiene norms" (maximum permissible concentrations) had been established for seventy constituents found in industrial waste waters, and that work is proceeding on thirty more substances.

Regulations governing the discharge of wastes classify waters or sections of waters into three categories, according to the purpose for which they are used. For each category different quality indicators are prescribed for application at the point of use. The following criteria are employed: Suspended matter, smell and taste, dissolved oxygen, five-day biochemical oxygen demand (BOD), hydrogen-ion reaction, color, pathogenic agents, toxic substances and floating impurities.

The first category embraces waters used for municipal supplies or bordering on fishery preserves. The second category comprises waters that are used privately for household and drinking supplies, or as spawning grounds for marketable fish. The third category includes sections situated within built-up areas not used for drinking water supply, but used for bathing or being of scenic interest. It also includes water used for commercial fishing or those waters traversed by fish on their way to the spawning grounds.

The most stringent requirements are those laid down for the protection of water in the first category; the lowest requirements apply to the third category. Thus, for example, after the waste discharge has mixed with the river or lake water, the BOD must not exceed two milligrams per liter in waters of the first category; four milligrams per liter is the standard for the second category; the BOD indicator is not used for waters of the third category.

Color requirements are stated in this fashion: When the waste water is mixed with distilled water in the proportion corresponding to its dilution in the river or lake, the solution must not show any obvious coloration in a column 20 centimeters high for the first category, 10 centimeters for the second and 5 centimeters for the third.

It is further stipulated that the waters of all three categories must not change in smell and taste under the influence of the addition of waste, that the dissolved oxygen content must not be less than four milligrams per liter, that the hydrogen-ion indicator (pH value) must remain within the range of 6.5-8.5, and that the proportion of toxic substances must not reach a value where it might directly or indirectly become harmful to human beings, animals or fish.

With the growth of the national economy, states Dr. Nagibina, the protection of waters in the Soviet Union is assuming even greater importance. Accordingly, in 1960, the Council of Ministers of the USSR focused attention on the need for intensification of efforts to protect the country's water resources from pollution, contamination and depletion by the issuance of a decree.

"This 1960 decree," said Dr. Nagibina, "lays down basic rules for the solution of problems relating to water-pollution control. It sets up special authorities responsible for the use and protection of water resources with inspectorates for the main river basins; it calls upon economic and Soviet organs (agencies) and the Soviet public in general to comply with the regulations for the protection of water resources and it again confirms the obligation of the state public-health organs (agencies) to prepare and publish requirements and rules on the basis of which waste can be discharged into waters without danger to public health."

Next month we will publish the concluding installment dealing with pollution-control practice in Czechoslovakia, Poland, Bulgaria, Roumania and Hungary.

TURN TO...

FLEX-O-LITE

FOR LEAD-FREE REFLECTIVE BEADS

Highway signs and markers reflectorized with whitest-white LEAD-FREE Flex-O-Lite Beads leap from the darkness to contribute greater safety for the motoring public ... greater satisfaction and economy for you.

FLEX-O-LITE PRODUCTS

No. 831 Lead-Free High Index of Refraction Beads and Sign Kits—Best for white and yellow signs • UB 68 Lead-Free Medium Index of Refraction Beads and Sign Kits—For darker colors • Type H Safety Spheres—For use where ultra-high brilliance is required • Traffic Beads: Free-Flowing, Moisture-Proof and Standard—For highway center lines and edgeline markings • All-Weather Airport Runway Beads • Also—Sign Bead Dispensers, automatic and semi-automatic types.

Write for catalog.

FLEX-O-LITE MANUFACTURING CORP.

8301 Flex-O-Lite Drive, St. Louis 23, Missouri • Paris, Texas

Flex-O-Lite of Canada, Ltd., P. O. Box 216, St. Thomas, Ont., Canada

COMPARE and you'll agree—

The New 1961 Asplundh Chippers Are Best for Municipalities

Asplundh Chippers are rugged, absolutely safe, are engineered for continuous, trouble-free service. They chip faster than any other chipper in the world; are easily maintained, simple in design, require less labor and materials cost.

New 1961 features include:

new wedge locking bar assembly for simpler, faster blade maintenance

replaceable floor plate, eliminates need for housing disassembly

larger diameter cylinder journals for a stronger chipping unit

removable cutter bar assembly to facilitate service

optional blower unit to preclude chute stoppage when chipping large volume of dense or wet foliage

DECIDE WITH THE FACTS . . . write for complete information . . . ask for names of users near you. Best of all, ask for a DEMONSTRATION WITHOUT OBLIGATION. What could be more conclusive?

Write today—

ASPLUNDH CHIPPER COMPANY

Hamilton St., Chalfont, Pa.

Proven in service by the world's largest tree company

Engineering Notes

Water Main and Sewer Line Costs

The total contract price for laying 8,980 ft. of water mains in Arvada, Colo., was $43,542.30. Work involved 8,980 ft. of trenching and backfilling at 39 cents a foot; 3,300 ft. of 10-in. cast iron pipe at $4.18; 5,320 ft. of 8-in. at $3.26; and 330 ft. of 6-in. at $2.55. Also 680 ft. of cut and replace asphalt pavement at $1 per ft.; and one creek crossing at $350.

A sanitary sewer project in Brighton, Colo., involved 1,490 ft. of 8-in. and 1,590 ft. of 10-in. extra strength VC pipe and 15 manholes; the bid for 1,500 ft. of selected bedding was $1 per ft. A lift station cost $16,000. Total contract price was $32,723.

Saving on Street Repairs

In Rockville, Md., the city engineer, John Gray, has been using bituminous concrete surfacing for street repair work. This he calls "smooth-seal." Basically, this is a surface course of bituminous concrete one-half to one inch in thickness applied under high pressure and high penetration, so that it seals deteriorating surfaces and adds strength to the total pavement structure. It is composed of a mineral aggregate coated with a paving grade asphalt having a penetration of 120-150, hot mixed, hot laid with a mechanical spreader and compacted on a properly prepared existing surface.

Close control of mixtures is vital to the success of the process. Frequent samples of the pavement are taken by the City Engineer's office and rigid control of mixtures is exercised during all phases of the work. Specifications for asphalt require it to be of such quality that, when extracted and recorded by the Abson method from the finished pavement, either binder or top course, the penetration of the extracted bituminous concrete shall be not less than 45 for 85-100 penetration asphalt and not less than 80 for 120-150 penetration asphalt.

The resulting pavement has multiple benefits. First, the cost is small. Second, it halts damage to roads which need major repair, but which, for budgetary reasons, cannot be completely rebuilt at once. It is particularly valuable in sealing roads to keep moisture out of the sub-base, which might otherwise cause heaving. Another advantage is that, because of the thinness of the surfacing, curbs and gutters are not lost.

Skidding Factors on Wet Pavements

Results of more than 400 tire skid tests on wet pavements which may some day help highway engineers build safer roads have been announced by Cornell Aeronautical Laboratory, Inc. of Buffalo.

In the tests, consideration was given to age of the highway surface, amount of traffic, temperatures and other conditions affecting pavements tested in 19 states from New York to California. Findings were as follows, according to a CAL engineer, William Close: Newer pavements offer better skid resistance than older ones. Data show that the portland cement concrete surfaces have higher average friction coefficients than other types of pavements tested. Pavements show less skid resistance to vehicles traveling at higher speeds. Materials used in the construction of pavements affect their skid resistance, as do the

Canton Job Moves Fast With Easy-To-Lay Concrete Pressure Pipe

In large photo at right, backhoe has dug trench and is lowering pipe into position.

Here workman lubricates rubber gasket for easy-to-make, bottle-tight joint.

Joint is made and crew checks position with alignment square.

Workman pours grout to finish up joint as crew moves ahead with additional sections.

This 17-mile line runs from the new Sugar Creek treatment plant southwest of Canton. The pre-stressed concrete steel cylinder pipe is mostly 42-inch, with some 36-inch. It is the kind of pipe you "bury and forget," requiring little or no maintenance. The Superintendent of Water at Canton is Alfred E. Ransom. Beiswenger, Hoch & Associates were the consulting engineers. The pipe was manufactured by Price Brothers Company with headquarters plants in Hattiesburg, Mississippi and Dayton, Ohio.

Price Brothers
CONCRETE PRESSURE PIPE

ESSICK

VIBRATING COMPACTORS

ESSICK VR-28-W PATCHING ASPHALT IN GARDEN GROVE, CALIF.

"MAINTENANCE PRODUCTION TRIPLED...

...COSTS DECREASED 80%"

SEWARD H. DART, STREET MAINTENANCE SUPERINTENDENT-SHOWN WATCHING HIS 28" ESSICK VIBRATING COMPACTOR IN ACTION—STATES:

"Irrigation water tracked into the intersections and gutter aprons in Garden Grove, constantly eroded the asphalt and made maintenance a full time problem. As a result, our gutter and intersection patching required frequent reworking, and our costs were high.

"After a demonstration of the 28" Essick Vibrating Compactor, we knew we had found the answer. It was self-propelled, hooked on the tail gate of a dump truck, and produced compaction equivalent to an 8 ton roller on asphalt. Its high frequency vibration compacts an asphalt patch that is completely dense—that can be opened immediately to traffic without any marking or damage to the asphalt.

"Now with our patching unit consisting of the 1½ ton dump truck, an Essick 120 gallon Truck Mounted Emulsion Unit, a propane torch, and the Essick VR-28-W Vibrating Compactor, the patch life has been tremendously extended, our maintenance production has tripled, and our costs have decreased 80%.

"The Essick VR-28 really solved the patch problem for us."

SELF PROPELLED — MANEUVERABLE — PORTABLE

Essick High Frequency Vibrating Compactors are constantly exceeding the densities and specifications performed by other compaction methods, while creating new standards of compaction for all types of fills, sub base, base materials, and asphalt.

CALL YOUR ESSICK DEALER FOR A DEMONSTRATION

9 Models of Vibrating Compactors from 13" to 72" Width

Also 14 models of Tandem Rollers from ½ to 14 Tons

ESSICK MANUFACTURING COMPANY

1950 Santa Fe Avenue, Los Angeles 21, California

850 Woodruff Lane, Elizabeth, New Jersey

Affiliated with THE T. L. SMITH COMPANY, Milwaukee, Wisconsin

methods used to finish some surfaces. The average friction coefficient value for the tests was 0.43, about half of that which might be obtained from the same tires on the same roads if they were dry.

Tests were made with a specially built trailer towed by a truck tractor equipped with a large water tank. As the driver applied the trailer brakes, water was sprayed on the road in front of the skidding tires. A speed of 40 miles per hour was maintained during this operation.

Drag produced by the locked wheels was measured by strain gauges. A meter in the cab gave the engineer conducting the test the friction coefficient of that particular section of highway. Weight carried by the trailer wheels was similar to that on the rear wheels of a conventional automobile.

Tests were made at predetermined intervals in rural sections, and the locations noted. Later, data on the construction history and traffic count for each direction were obtained and tabulated. Cross plots were made to indicate the effects of age, traffic volume, surface finish and aggregate composition for the portland cement concrete pavements. The comparative effects of age on the skid resistance of portland cement concrete and bituminous asphalt roads were also summarized.

Flood Control for a College

More than three million cubic yards of material are being moved for construction of protective works for flood control at Clemson College, Clemson, S.C. The work includes building two dams, a dike and pumping station to prevent flooding of the campus, stadium and agricultural land by the Seneca River.

The upsteam diversion dam will be 2,200 feet long, the lower dam 3,000 feet, and the dike adjacent to the lower dam 2,000 feet. This part of the reservoir will have a normal water depth of 41 feet, with a 60-foot high water mark. The pumping station will be located at the lower dam, and will drain the area sealed by the dams.

Nello L. Teer Company, of Durham, N.C., the prime contractor, is using five International Payscrapers for a major share of the earthmoving. The units, working a one-half-mile haul, are averaging 105 loads each 10-hour shift. The project is under direction of the Savannah, Ga., district, U.S. Army Corps of Engineers, and is scheduled for completion this coming July.

Advanced Techniques in State Highway Work

In a paper by H.A. Radzikowski, Chief of the Division of Development, Bureau of Public Roads, before the AASHO, advanced techniques used by state highway departments were summarized as follows: In addition to using electronic computers 40 hours a week for highway engineering production work, 34 state highway departments and the Bureau of Public Roads are using the equivalent of 7.5 electronic computers each full week for the development of improved engineering practices; 35 state highway departments are utilizing airplanes for reconnaissance and location work, for the location of highway construction materials and for securing data to speed up payments to contractors; 27 state highway departments are exploring the use of nuclear density-moisture gages for inproved quality control; and 10 state highway departments are using infrared spectroscopy for testing one or more of the following: cement, paint, asphalt, concrete additives, limestone, steel, aluminum, weed poisons, sulphur in diesel fuel and propylene glycol in antifreeze.

960 million gallons per day!

Photo Courtesy Chicago Tribune

LINK-BELT Straightline sludge collectors at world's largest water filtration plant

Chicago Central-District Water Filtration Plant—Scheduled to begin service in 1962, it will boast a working capacity of 960 million gallons per day! The main structure alone measures more than 3300 feet long, 968 feet wide. Costs will run to some $102,000,000.

Sludge removal on this mammoth scale involves nearly 20 miles of Link-Belt chain (some 200,000 links!) . . . 144 longitudinal collectors . . . 16 cross collectors . . . 1248 collector sprockets . . . over 3700 redwood flights.

The high efficiency of Link-Belt *Straightline collectors* is reaffirmed continually in specifications for new waterworks construction. Sludge travels the shortest possible distance, at rates that assure minimum disturbance. Tank shape allows even flow distribution. And, no other collector matches Straightline's record for long life with minimum attention.

Whatever the scale you build on, large or small, look to Link-Belt for assistance in planning and equipping your water, sewage or waste-treatment facilities. Our sanitary engineering specialists will be glad to cooperate closely with you, your chemists and consultants. Call your nearest Link-Belt office for assistance *now*. 91.607

Link-Belt Type-H Straightline sludge collectors—similar to those being installed in the new Chicago Central-District Water Filtration Plant. Units shown here are actually part of the settling-tank system of the Queen Lane Water Filtration Plant in Philadelphia.

LINK-BELT

SANITARY ENGINEERING EQUIPMENT

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. Sanitary Engineering Regional Office—Atlanta, Chicago 9, Colmar, Pa., Kansas City 8, Mo., San Francisco 24. District Sales Offices in All Principal Cities. Export Office, New York 7. Representatives Throughout the World.

See our exhibit, A.W.W.A. Convention, Detroit, June 4-9.

Hardly! You see, Transite®, the *white sewer pipe,* is made of ageless minerals—asbestos and cement. The asbestos fibers, each with the tensile strength of piano wire, reinforce the cement to form a stone-like pipe that is rugged, tough and durable. Transite is also steam-cured under high pressure, adding further to its strength, durability and chemical stability. And, being non-metallic, there's no chance of oxidation weakening its structure. What's more, Transite's high crushing strength can withstand the heavy overburden, ground movement and earth shocks that continually challenge the ability of sewer pipe. When you add to this Transite's long lengths, tight joints and naturally smooth interior, it becomes obvious that this white sewer pipe was designed to offer greater total life expectancy.

For all the facts, write for special data file. Please indicate if you are a city official, engineer or contractor. Address: Johns-Manville, Special Sewer Data, Box 14, PW-4, New York 16, N. Y. In Canada: Port Credit, Ont. Cable address: Johnmanvil.

The Transite Pipe shown in this 23-year-old photo is still providing trouble-free service.

JOHNS-MANVILLE
TRANSITE SEWER PIPE

From fill to finish...

Seaman products build better roads at lower cost

DUO-PACTORS
By combining steel and rubber rolls, Duo-Pactor gives you a complete compaction and surface rolling system from initial fill to base course and seal coat or bituminous mat, all in one low-cost, self-propelled unit. Rubber tires closely spaced to minimize material displacement, form compacted tracks of high density. The steel roll chokes the ridged material down between the compacted tracks, thus unifying density across the entire rolling width. *On any kind of material Duo-Paction produces higher, more uniform densities* at far lower cost than any one-purpose compaction equipment. Choose from four models including the TRI-PACTOR which combines Duo-Paction with vibratory impact.

IMPACTORS
Trailing vibratory impact roller delivers tamping force up to 25,000 lb at 600 to 1,400 ipm. Vibrating element is externally mounted, for easy accessibility.

UTILITY SCRAPER
Self-loads up to 6 cu yd. Built-in scarifier often eliminates second tractor unit on job. Self transporting without permit. Sized and priced for profits on small earthmoving jobs and big-job clean-up work.

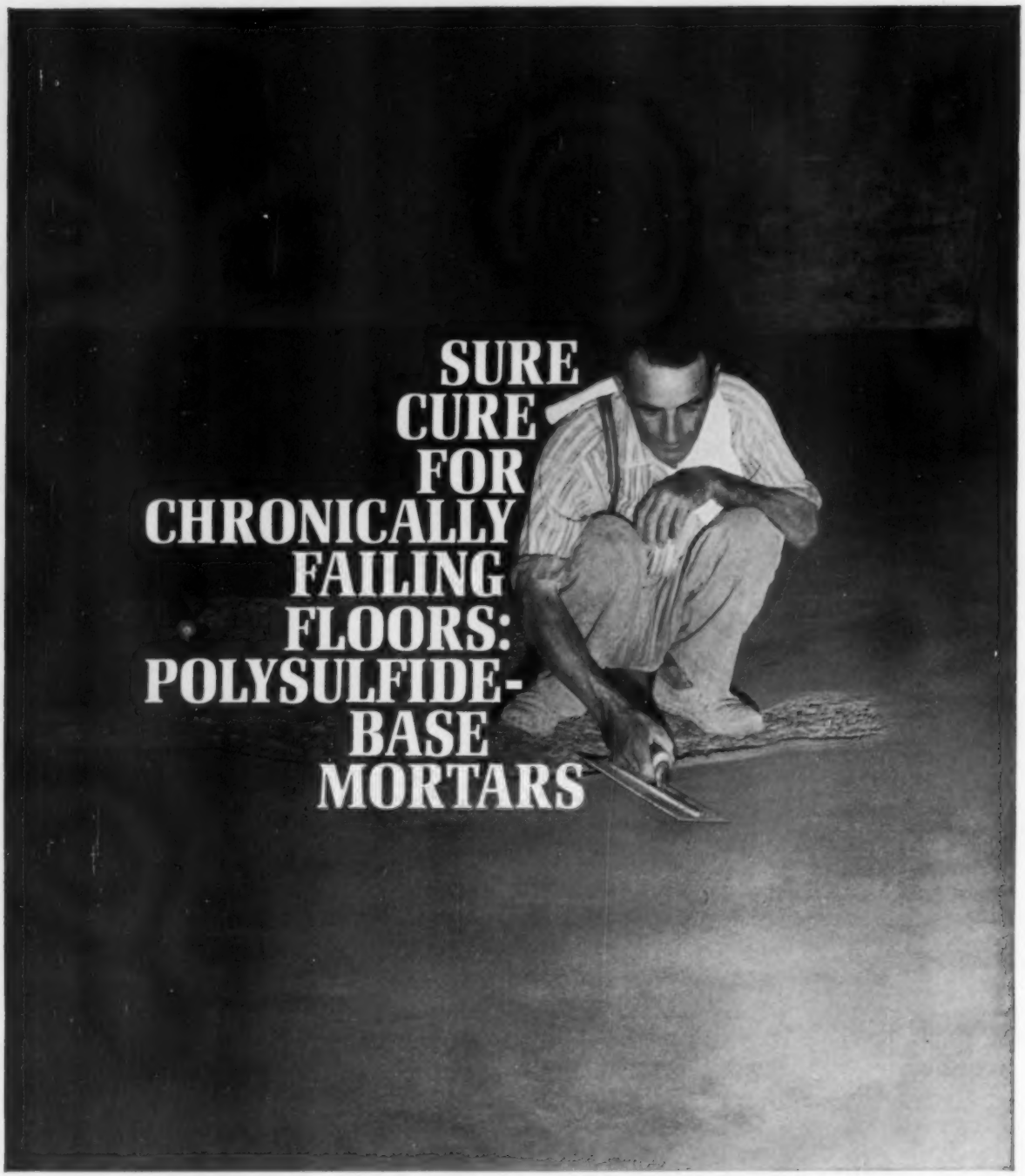
BITUMINOUS DISTRIBUTORS
Up-front control keeps the operator away from fumes, provides instant contact with the driver, and clear visibility for spray control.

STREET FLUSHERS—Hydro-Jet power system produces a powerful stream that scours, instead of just flushing greasy pavement. Centrifugal pump delivers up to 850 gpm.

For specification sheets on any Seaman product shown above or on soil stabilization equipment, write:

SEAMAN-GUNNISON
DIVISION OF
SEAMAN CORP.
MILWAUKEE, WISC., U.S.A.

P.O.Box 3025, Milwaukee 18, Wis.
Tel.: SUnset 1-8900

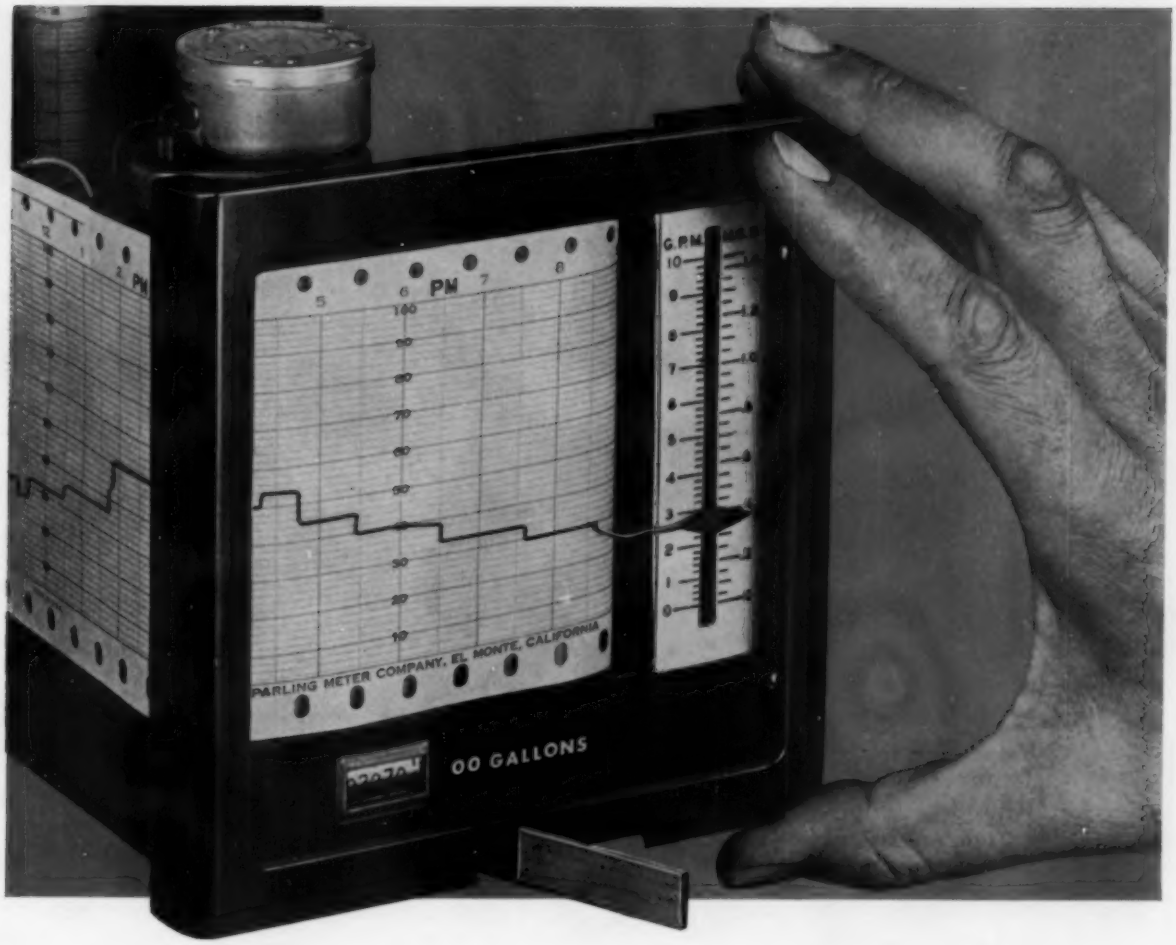


In more and more industrial buildings where manufacturing processes have raised havoc with conventional floors and have caused a continuing cycle of restoration, THIOKOL polysulfide-base flooring compounds are delivering long trouble-free service and decreasing maintenance costs.

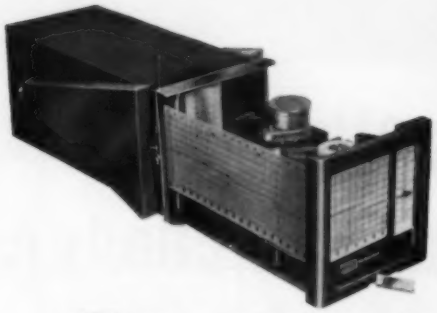
THIOKOL polysulfide polymer is synthetic rubber in liquid form. It is famous for spectacular adhesion, elasticity, and resistance to oils, solvents, acids, chemicals, water and temperature extremes. As a mortar base with epoxy, it stands up to heavy traffic, abrasion, chemical attack like no other flooring compound. It can be applied over existing surfaces regardless of their composition, and has proven its serviceability in scores of installations.

Polysulfide-base mortars provide a smooth or skidproof surface, as desired—are ready for traffic in less than one day—and last for years under abusive wear and exposure to disintegrating elements. For full information, write to Thiokol Chemical Corporation at address below, for Brochure FC-100.

Thiokol®
CHEMICAL CORPORATION
780 N. Clinton Ave., Trenton 7, N. J.
In Canada: Naugatuck Chemicals Division, Dominion Rubber Company, Elmira, Ontario



New SPARLING MINIATURE STRIP CHART INDICATOR • TOTALIZER • RECORDER



COMPLETE FLOW INFORMATION IN LESS THAN 1/4 PANEL SPACE

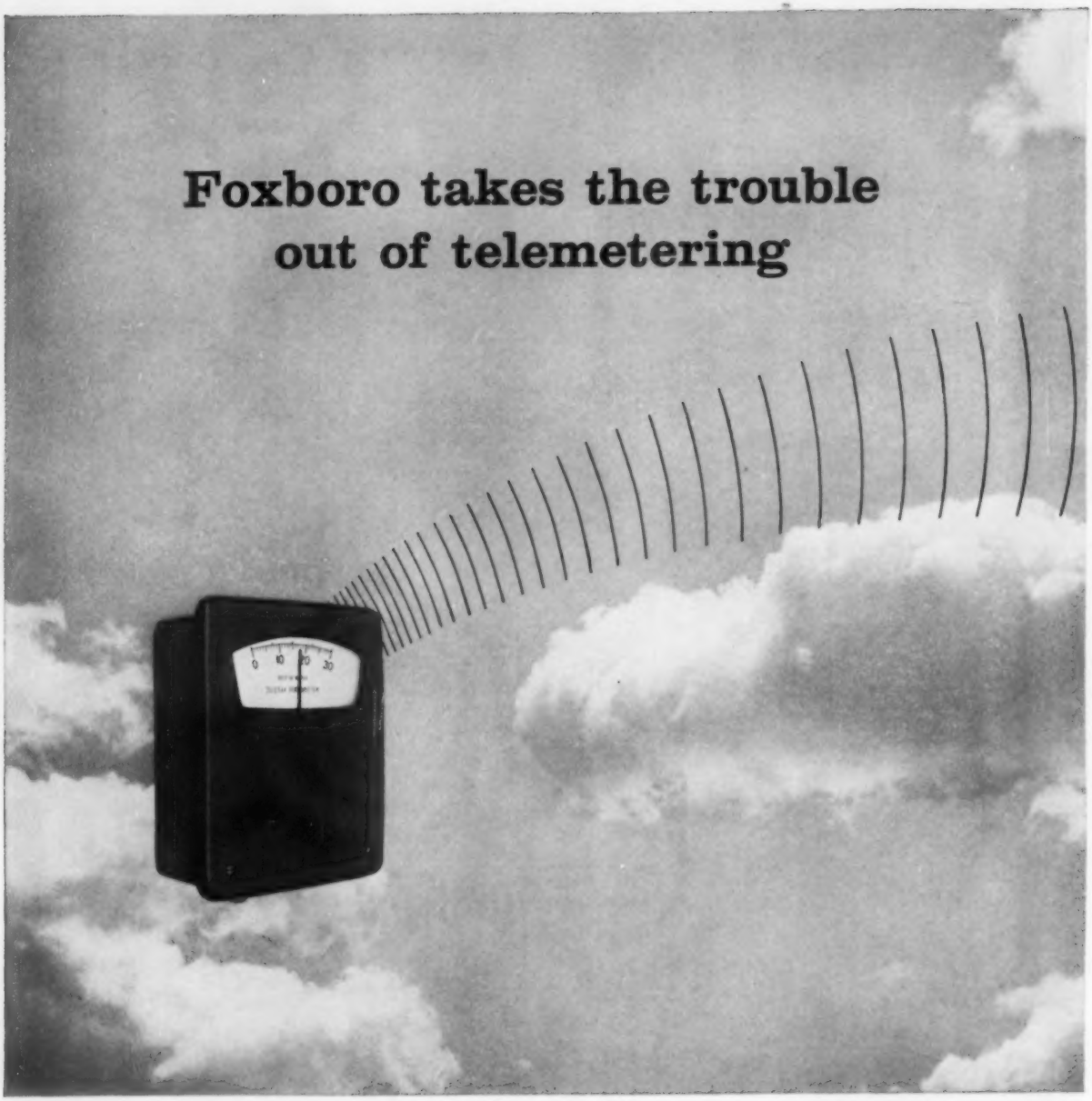
Indication, *totalization* and recording—the same as in full size instrumentation—are all provided in this new, compact unit. Uses standard components, yet requires little more than 6" square panel area. Has 6-digit totalizer, dual equivalent scales, and effective range of 20:1. 60 or 120 day records. When chassis is removed, 26 hours of records are visible without moving chart. Ideal for graphic or conventional panels, and standard electronic racks. WRITE FOR TECHNICAL BULLETIN CF-390.

Sparling equipment includes a complete line of instruments, controls and propeller meters for all main-line requirements.

SPARLING
WATER CONTROL EQUIPMENT

HERSEY-SPARLING
METER COMPANY
Sparling Equipment: **EL MONTE, CALIF.**
225 North Temple City Blvd.

Branches: Atlanta • Chicago • Cleveland • Dallas • Denver • Kansas City, Mo. • Roselle, N. J. • San Francisco • Seattle • United Kingdom Affiliate: TYLORS OF LONDON LTD.

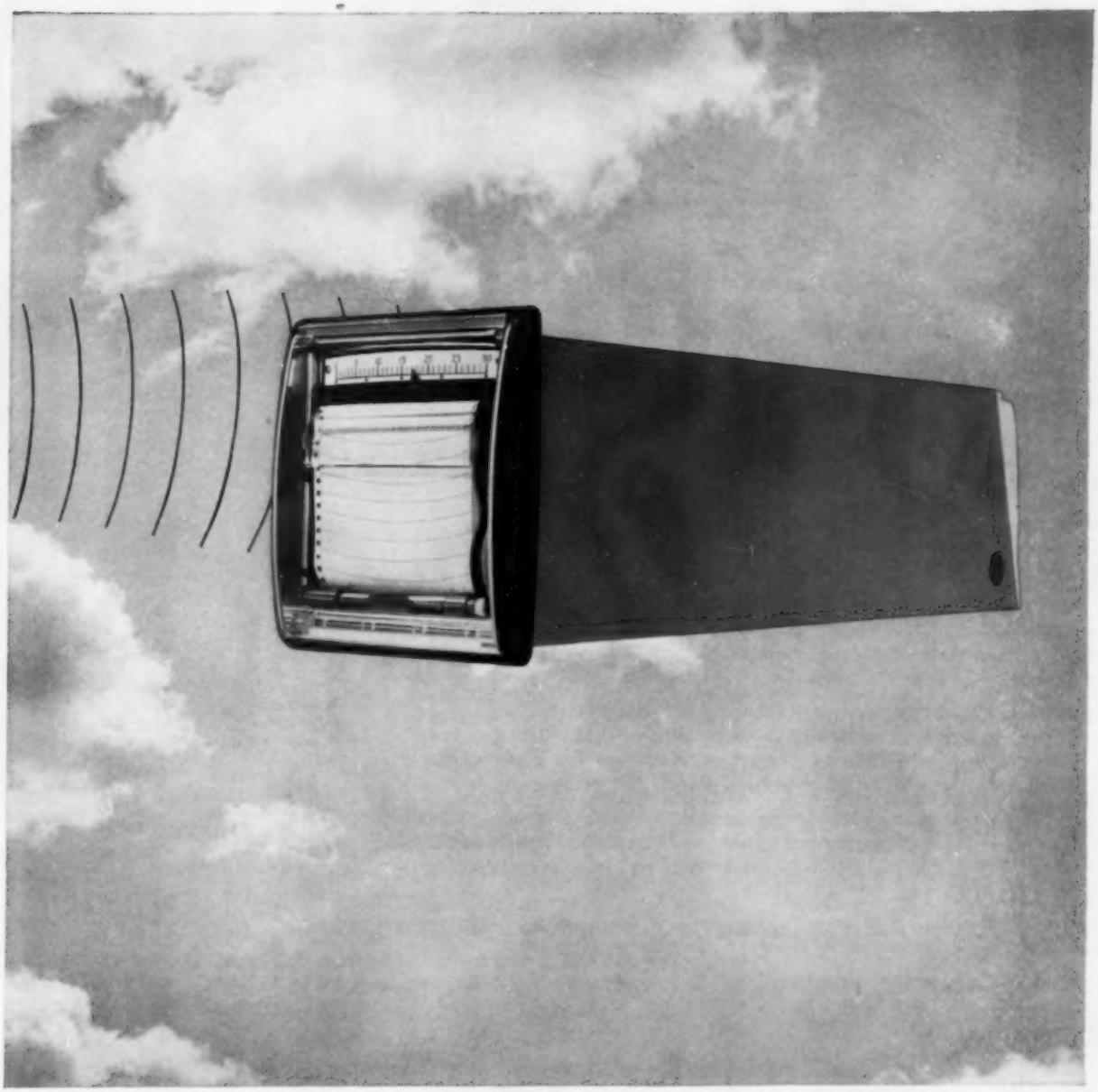


new, 2-second cycle, all-electronic eliminates mercury switches...

A giant step forward in the science of telemetering measured variables — this is Foxboro's new telemetering system.

Completely electronic, the system abandons earlier mechanical means of producing a pulse-duration signal. Dry reed switches replace troublesome mercury switches . . . a photo-diode switch replaces the mechanical cam switch. There are no synchronization problems . . . no vacuum tubes . . . no periodic maintenance.

Standard impulse-duration cycle on the new Foxboro telemetering system is 2 seconds — 4 times as fast as any other standard system. The signal can be carried over any



telemetering system makes maintenance "plug-in simple"

transmission medium. Modular construction makes servicing easy as "plugging-in" a new component.

This is the telemetering system all industry has been asking for. For full details, write for Bulletin 17-12. Or better yet, ask your Foxboro Field Engineer for the complete story. The Foxboro Company, 265 Norfolk Street, Foxboro, Mass.

FOXBORO

REG. U.S. PAT. OFF.

*Reg. U.S. Pat. Off.

you can't PATCH IT!

Some things can't be patched, let's face it. Among them are a bond issue and a sewer line. If either fails, you start all over again—and that's expensive.

If your city puts inferior sewer pipe in the ground —and gases and acids ruin it—somebody's got to dig it up and replace it. That costs you—the taxpayer—a whole lot more money than putting down lifetime pipe in the first place.

Putting in an inferior sewer pipe is a real penny-wise, pound-foolish idea, anyway. The big cost of putting in a sewer line is tearing up streets and digging the ditch, NOT the pipe. Actually the pipe—the best, lifetime pipe—averages about only 12 percent of the cost of the job.

Lifetime pipe is Vitrified Clay Pipe. It can save you untold tax dollars in the long run.

No, you can't patch a sewer line any more than you can a bond issue. But you can patch a hole in your money pocket—and the time to patch it is before you've lost a lot of money. That means demanding lifetime pipe—Vitrified Clay Pipe—for the next sewer line in your community.

Public health is important. Your city may need to upgrade its sewer lines.

Find out how by writing to:

NATIONAL CLAY PIPE MANUFACTURERS, INC.
1028 Connecticut Ave., Washington, D. C.

Please send me full details on the new factory-made compression joints on Clay Pipe.

(name)

(company)

(street address)

(city and state) B-4C1PW

COMPRESSION SEALED, VITRIFIED

CLAY PIPE

IMPERVIOUS

THE STANDARD in SANITARY SEWERS

NATIONAL CLAY PIPE MANUFACTURERS, INC.

1028 Connecticut Avenue Washington 6, D. C.

The Removal of ABS from Sewage

PUBLIC WORKS MAGAZINE
VOL. 92, No. 5
MAY, 1961

P. H. McGAUHEY
and
STEPHEN A. KLEIN
University of California,
Berkeley, California

IT IS proverbially true that he who empties the wastebasket may not specify its contents. Where the public wastebasket is concerned, it is the responsibility of those who operate and manage sewerage systems, develop waste treatment processes, or incorporate such processes into treatment plant design, to deal in a satisfactory manner with whatever the public discharges to its sewers. Some restrictions must, of course, be imposed but the list includes neither simple nor compound headaches for those concerned with the fate of water-borne wastes. In general, a maximum freedom of waste discharges is maintained and only those things are excluded which may physically clog the sewer in a relatively short period of time; which may endanger life by exploding in the system; which disintegrate concrete structures; which are grossly toxic to biological treatment systems; or which survive treatment processes in quantities known to endanger human health or to create a serious nuisance. Noisy but ineffectual public concern is also expressed for wildlife and, on occasion, recreational use of waters becomes a reason for restriction of discharges.

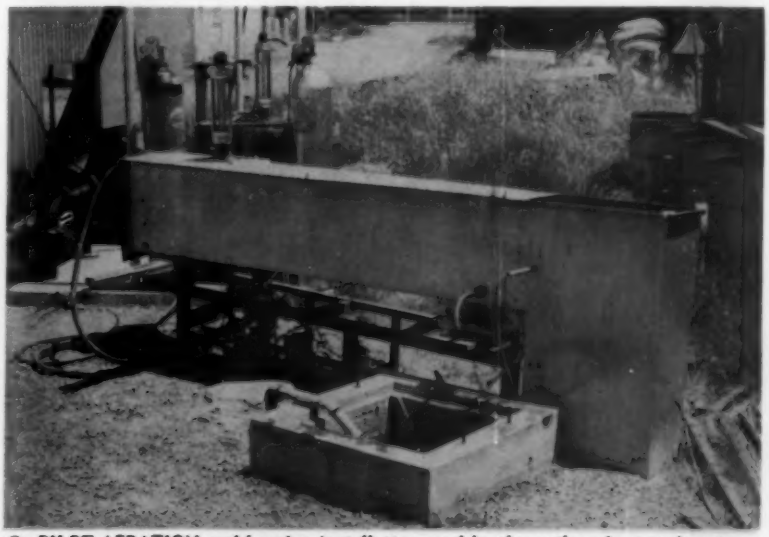
In spite of the lack of freedom of selection inherent in waste handling responsibilities, it might be expected that treatment practice would reach a state characterized by a slow and orderly increase in efficiency with growing knowledge of biochemical systems, were it not for the rapid rise of new industrial processes and of new commercial products for use in the home. In this latter category, none has been more striking than the development of synthetic household detergents, in which alkyl benzene sulfonate (ABS) is the most common surface active agent.

It is the purpose of this article to discuss the reasons why ABS removal may become one of the objectives of sewage treatment, and to summarize the current status of known ABS removal methods.

Why Remove ABS

The precise significance of any particular amount of ABS in sewage or in waste treatment plant effluents is unknown. However, there are considerations of nuisance as well as increasing implications of environmental sanitation, which could lead to a demand for reduction in the ABS content of waste waters. Such a demand could result in either a prohibition of the discharge of ABS to sewers or a requirement that sewage treatment involve ABS removal. In some European countries, notably England and West Germany, where lesser per capita use of water makes for more concentrated domestic sewages than are typical of the U.S.A., and where intensive use and re-use of river waters is made unavoidable by concentrated populations, restrictions on the discharge of ABS seem imminent. In reality, this restriction would require substituting for ABS a more expensive surface active agent having a "straight chain" molecular structure readily broken down by existing sewage treatment processes.

In the United States, however, any demand for ABS reduction seems more likely first to emphasize treatment processes rather than modification of the surfactant itself. Weaker sewage, lesser governmental control of industry, and economic considerations are among the reasons why this is so. More important, however, is the traditional expectation that the treatment plant will take care of whatever comes down the sewer, within the normal limitations previously cited. At present, ABS does not clog sewers, except in instances where it may



● **PILOT AERATION and burning installation used by the authors in experiments on removal of frothing materials by surface stripping and the destruction of the froth.**

have broken loose old accumulations of grease. Frothing of sewage treatment plants, to which it contributes, can be controlled by known methods. Its toxicity to biological treatment systems in concentrations of 5 to 10 mg/L in sewage is debatable, and no evidence of toxicity to humans in expected amounts has been reported. On the other hand, the European experience may be prophetic of future United States conditions. A proposed esthetic standard of 0.5 mg/L maximum ABS for drinking water may impose serious limits on individual treatment plant effluents. Furthermore, the unknown behavior of ABS underground has become a new reason for prohibiting recharge of ground water with sewage effluent, and, in the face of a growing need for water reclamation, may force a reconsideration of restrictive policies. In addition, frothing discharges from treatment plants, and of streams receiving them, are causing both citizens and fish and game commissions to become increasingly restive. All of these factors indicate that in the future sewage treatment objectives may include removal of ABS.

How May ABS Be Removed

There are two general approaches to ABS removal from waste waters: 1) by normal sewage treatment processes, and 2) by special treatment procedures. Investigative work along both of these lines is being conducted by various research groups throughout the United States and Europe. The following report on the status of ABS removal, however, is drawn largely from the results of past and current studies in which the authors have participated under the sponsorship of the Association of American Soap and Glycerin Producers, and the National Institutes of Health of the Public Health Service.

Use of Normal Processes

Primary Sedimentation. Early reports in the literature (1) suggested that the normal sedimentation process used in primary sewage treatment effected an important degree of ABS removal of the order of 30 percent. Researchers, however, were aware of the vagaries of colorimetric techniques on which these results were based, but no estimate of the magnitude of error involved was possible prior to the development of methods of radioassay. Table 1, derived from studies (2) of sedimentation in which sulfur-35 was substituted for sulfur in the ABS molecule, shows the effectiveness of sedimentation in removing ABS from sewage to be disappointingly small. Only about 11 percent of the ABS proved to be associated with filterable suspended sewage solids, while but some 3 percent was removed with the solids settling out in a normal 2-hour detention period. Subsequent experimental work indicated that a value of 2 percent might be more typical of the removal of ABS by primary sedimentation.

Table 1—Removal of ABS[35] by Sedimentation and Filtration

Material Observed	ABS Removed (Percent) Test No. 1	Test No. 2	Test No. 3	Avg.
Raw Sewage	0	0	0	0
Settled (2-hr)	3.6	3.3	2.5	3.1
Filtered	12.1	10.5	—	11.3

Activated Sludge. The ability of activated sludge to remove ABS from sewage by bio-degradation was studied in laboratory and pilot scale units over a period of some four years (1). Table 2 presents typical results which led the authors to conclude that activated sludge may be expected to remove an average of 50 to 60 percent of ABS when its initial concentration is within the range occurring in raw sewage in the United States. Although Table 2 shows a fairly constant level of ABS removal, averaging some 54 percent, many other experiments showed daily variations in the range of 15 to 70 percent, while producing a similar value of average removal. A constantly high BOD reduction by the activated sludge units utilized demonstrated that the inconsistent ability of activated sludge to degrade ABS is independent of its ability to treat sewage.

Studies of the effect of varying such factors as aeration rate, period of aeration, and solids concentration in the mixed liquor within limits practical for activated sludge plants failed to yield major increases in ABS removal, although as illustrated in Table 3 for solids concentration, such factors are not without effect. They do not, however, modify the conclusion that an average of 50 to 60 percent of the ABS presently expected in American sewage may be removed by secondary sewage treatment by activated sludge. On the other hand, preliminary reports from the Hyperion Plant at Los Angeles indicate that a full scale plant may be appreciably more effective than pilot models.

Table 2—Removal of ABS[35] by Activated Sludge

Days	ABS in Sewage (mg/L)	Reduction (Percent) BOD	ABS
1	2.25	66	75.9
4	3.8	87	48.6
6	3.8	95	54.3
7	4.0	91	54.2
8	2.2	93	57.6
11	3.8	91	68.4
13	3.9	...	58.7
14	2.6	83	47.6
18	4.0	56	37.7
19	9.0	85	48.0
20	...	85	56.3
21	8.0	...	52.3
25	4.0	96	46.2
26	3.6	90	54.6
27	4.6	74	57.6
28	...	92	60.4

Trickling Filters. The ability of sewage filters to remove ABS from sewage was studied (3) with a pilot-scale filter operated at various rates of recirculation. The results, summarized in Table 4, show that only about 25 percent removals were obtained under conditions which produced a high level of sewage treatment as indicated by BOD reduction.

Field scale observations of trickling filters in England (4) produced one instance of high (91 percent) ABS removal, but subsequent and more extensive observations (4) yielded values of 39 and 58 percent removal, respectively, for two installations. In both cases, as in the authors' experiments, filters were found to be less effective than activated sludge in removing ABS.

Conclusion. While in any particular instance a prototype plant may give higher ABS reductions than observed in the reported experiments, mounting evidence of the presence of ABS in surface and ground waters leads to the conclusion that normal sewage treatment processes are not adequate. Hence,

Table 3—Effect of Solids Concentration in Activated Sludge Mixed Liquor

No. of Days	Solids Conc. (mg/L)	Reduction, Percent ABS	BOD
70	1,432	39.4	88
38	2,038	51.6	94
12	3,696	54.1	97

Table 4—Average Removal of ABS by Trickling Filter

Run No.	Days	Recirculation Ratio	Filter Loading (Lbs. BOD/cu. yd. Filter)*	Filter Loading (Lbs. BOD/cu. yd. Effective Filter)	BOD Reduction (%)	ABS Reduction (%)
1	46	1:1	0.20	0.12	74.5	8.3
2	18	3:1	0.59	0.26	88.9	24.8
3	24	9:1	0.32	0.12	94.6	26.6
4	22	1.6:1	1.37	0.70	59.0	7.6

*Calculated on the basis of the recirculation ratio.

if ABS removal becomes a deliberate objective of sewage treatment, special ABS removal procedures will be necessary in many instances.

Use of Special Processes

Special procedures for ABS removal might take the form of modification of existing processes, or the introduction of intermediate or tertiary steps not presently part of a sewage treatment plant. Studies of both such possibilities have been conducted and the more hopeful are currently being continued in search of economic solutions.

Modification of Existing Processes. Efforts to enhance ABS removal by altering existing sewage treatment processes were confined largely to the activated sludge process since it alone achieved normal values of appreciable magnitude. Best results were obtained at high solids concentrations (5000 ±mg/L) where rapid sludge growth conditions were maintained. This, however, boosted the average ABS removal only about 10 percent above the expected normal of 50 percent, while exhibiting the same wide fluctuation in daily removals characteristic of the normal plant.

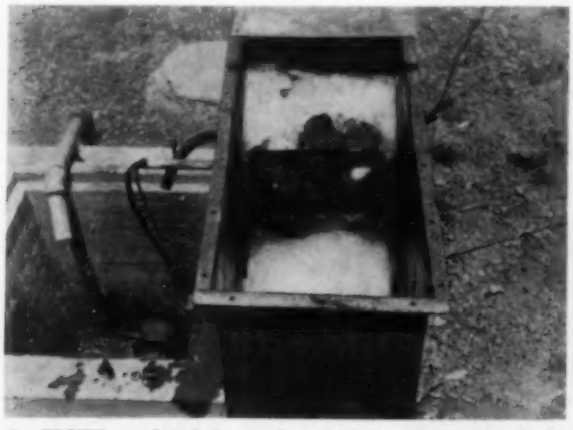
Two activated sludge units in series were no more effective than a single unit. Neither was a system in which the activated sludge carrying most of the quickly adsorbed unstable solids was diverted to a separate aeration tank after one hour, in hope of attenuating the organisms to the remaining high-ABS-low-BOD residue. Such an attenuation did not occur, although a surprisingly high concentration of activated sludge was maintained on the low BOD substrate. From those and several other experiments it was concluded that modification of the existing activated sludge process is not a hopeful means of ABS removal at a high level.

Special Processes. By employing the well known fact that a surface active agent is concentrated in the froth when frothing occurs, the authors developed a forced aeration process which they chose to call "surface stripping." It involves two principal steps: 1) induced frothing by aeration, and 2) froth removal and disposal.

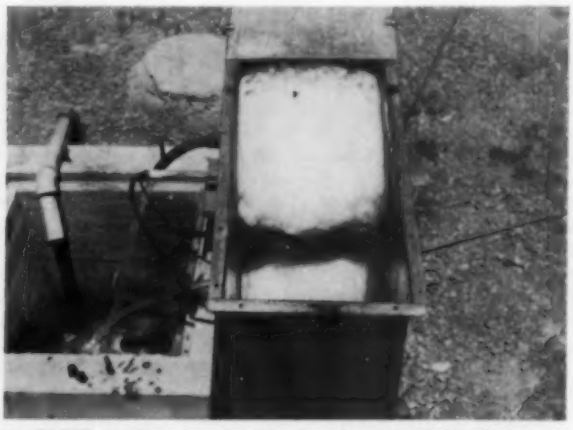
The procedure in the first step is to pass the sewage through a narrow tank having a false bottom of aloxite air diffusion plates located above an air manifold. Intense aeration at a rate of about one cubic foot per gallon of sewage treated during a 15-minute or shorter aeration period concentrates more than 80 percent of 10 mg/L influent ABS in the froth. By covering the frothing tank, the escaping air is made to strip the froth from the liquid surface and deliver it through a side port into a separate chamber.

Induced frothing was found to be equally effective, whether applied to primary or secondary sewage effluent, despite the fact that one half of the ABS had already been removed from the secondary effluent by activated sludge. In either case, a minimum residual of one mg/L ABS was achieved regardless of the original ABS in the sewage frothed. The reason, of course, is that the ability of ABS to act as a frothing agent is a function of its concentration, hence as the concentration diminishes a point is reached where aeration causes only turbulence of liquid without producing any appreciable froth. This point evidently lies at one mg/L for domestic sewage. A second aeration of effluent containing one mg/L found to reduce further the concentration in the liquid, but is too inefficient for practical ABS removal below one mg/L.

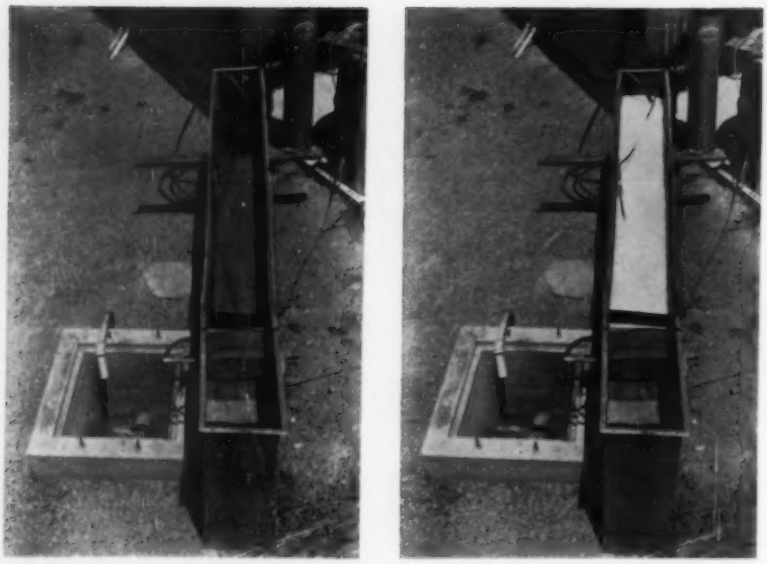
From a theoretical viewpoint the surface stripping process might be applied either as an intermediate or a tertiary process. Practically, the problem of froth disposal makes it essentially a tertiary process. Concentration of ABS in froth was found to vary from some 400 to 850 times that in the sewage treated, the wetter froths coming from primary sewage and entrained water being a function of a number of variables, including intensity of



● FROTH produced by surface stripping is automatically extruded into the burning chamber; no burning is in process.



● FROTH in burning chamber has been partially destroyed. Economical disposal of froth is still a subject of research.



● **AERATION plate arrangement in the pilot plant for surface stripping is shown at left above. At the right is shown typical induced froth produced in pilot tank.**

aeration. Thus, under the best of conditions an appreciable quantity of liquid, perhaps 3000 gallons per million gallons of sewage treated, is associated with the separated froth. Evaporation of this liquid during total incineration has been accomplished by extruding the froth into a burning chamber using commercial gas as a fuel. Partial incineration to reduce froth to a liquid residue has also proved successful. However, disposal of froth in an economical manner remains a subject of the authors' current research.

Ion Exchange and Adsorption. Reduction of ABS in the final effluent from sewage treatment plants before release to receiving waters is being investigated from the standpoint of ion exchange and absorption in soils. In a recent paper (5) some success in tying up ABS by ion exchange is reported, although little hope for its early development as a practical and economical method of ABS removal is expressed. Several investigators, including the authors, are engaged in studies which should reveal incidentally any possibility of ABS removal by adsorption on soil during ground water recharge through surface spreading of effluents. At present there is little theoretical reason to expect, or evidence to support, an optimistic view of adsorption on soil as a practical method of ABS removal.

Summary Discussion

Within the past two years an increasing concern for water as a national resource has become evident. Attention is repeatedly called to the water needs of an explosively expanding population and of the industry and agriculture which sustains it, particular emphasis being placed, at both a local and national level, on the importance of water quality. Answers to the repeated question of the behavior of synthetic detergents, notably of ABS, underground, and of its significance in surface and ground water supplies, are being sought through sponsored research, while consideration is being given to the establishment of limits on ABS in receiving water. In England and Germany, serious consideration is being given to requiring the householder to use a detergent involving a surface active agent readily decomposed by the normal biochemical processes presently used in sewage treatment. All of these factors suggest that in the United States as well, restrictions on the discharge of ABS into the aquatic environment will be necessary. Present indications, however, are that such restrictions will lead to ABS removal as one of the goals of modern sewage treatment rather than to a prohibition of the use of ABS in household detergents.

In view of the considerations, the authors, among others, have conducted investigations under the sponsorship of both industry and government, of possible methods of ABS removal. These studies show that existing sewage treatment processes are not generally adequate to meet greater needs for ABS removal than are presently imposed. Sedimentation removes but two or three percent of the 5 to 10 mg/L ABS estimated to be typical of domestic sewage in the United States. Activated sludge, however, may remove some 50 to 60 percent, while the trickling filter may account for some lesser amount. Investigate work on modification of the activated sludge process to enhance its efficiency in ABS removal has not produced encouraging results. On the other hand, ABS can be reduced to one mg/L quite readily by a process called "surface stripping" by the authors, and involving both induced forthing by aeration and froth disposal. The basis for an economic design of the first step has been established. Economical froth disposal, however, is a continuing goal of current research.

Additional research in progress at a number of institutions in the United States, including the University of California, should yield information useful in establishing intelligent standards for receiving waters should removal of ABS from sewage become necessary. These include such factors as the behavior of ABS in percolating water or in aquifers; methods for reducing ABS below the one mg/L concentration already shown to be feasible; and the significance of various concentrations of ABS in the human and aquatic environments.

References

1. McGauhey, P. H., Crosby, E. H., and Klein, S. A., "The Fate of Alkylbenzenesulfonate in Sewage Treatment," Final Report, Univ. of Calif., San. Eng. Res. Lab., Berkeley, Calif. (July, 1957).
2. McGauhey, P. H., and Klein, S. A., "Removal of ABS by Sewage Treatment," *Sewage and Industrial Wastes*, 31(8):877-899 (Aug., 1959).
3. McGauhey, P. H., Klein, S. A., and Palmer, P. B., "A Study of Operating Variables As They Affect ABS Removal by Sewage Treatment Plants." Final Report, Univ. of Calif., San. Eng. Res. Lab., Berkeley, Calif. (Oct. 1959).
4. Roberts, F. W. and Lawson, G. R., "Some Determinations of the Synthetic Detergent Content of Sewage Sludge," *Water and Waste Treatment Journal*, 7, 14-17, May/June 1958; Abstract, *Public Health Engineering*, *38*, 12, 26, Dec., 1958.
5. Roberts, F. W., "The Removal of Anionic Syndets by Biological Purification Processes—Observations at Lutin and Letchworth," *Water and Wastes Treatment Journal* (British), *6*, 7, 302, 1957; Abstract, *Sewage and Industrial Wastes*, 30, 1, 121, Jan. 1958.
6. Abrams, I. M. and Lemon, S. M., "Removal of Alkylbenzenesulfonate from Water by Chloride Cycle Anion Exchange," Chemical Process Co., Redwood City, Calif.

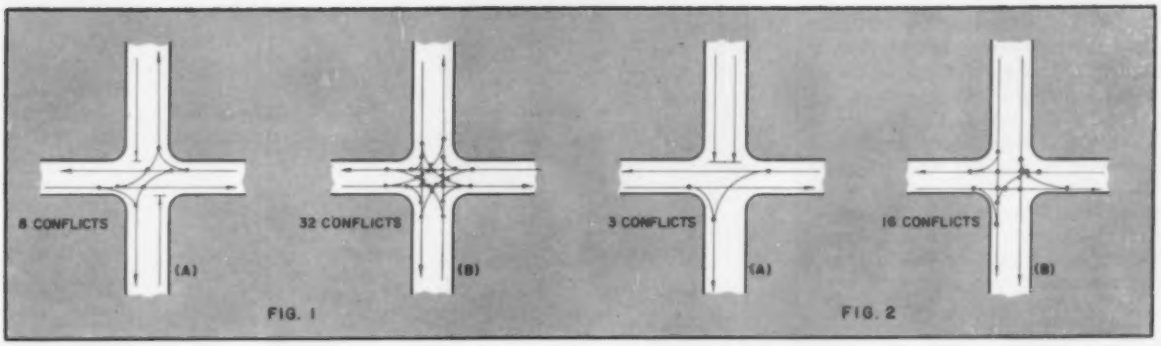


FIG. 1 FIG. 2

PRINCIPLES and FUNDAMENTALS of INTERSECTION CHANNELIZATION

WILLIAM C. KERR
Assistant Instructor
Michigan State University
East Lansing, Michigan

STREET AND HIGHWAY intersections are points at which two or more traffic streams meet, and at which there is an interchange of direction of flow. These points, then, represent locations of conflict and thus warrant the attention of the highway engineer.

A tall building cannot be merely an assemblage of beams, girders and columns; it must have connections which properly transmit the various loads to the foundation. Similarly, a street system must have connections or intersections to transmit the traffic flow from one point to another. The geometric design engineer is concerned with this problem, and one of the techniques available to him is channelization.

Channelization implies a separation of traffic streams. The various benefits accruing to this separation generally are: Increased capacity, reduced delay, decreased driver confusion, a reduction of accident potential, and decreased cost of vehicle operation through the area.

There are essentially six specific purposes which channelization may fulfill in order to bring about the aforementioned results. These are:

1) Separation of "conflict points," that is, points at which traffic streams merge, diverge or cross, giving the driver a minimum number of decisions to make at any one time.

2) Provision of merging lanes or special turning paths for easier maneuvering.

3) Reduction of vast areas of pavement which result when many streets intersect. Curbed islands are used to confine the vehicles to definite paths of travel.

4) The prevention of wrong turns.

5) Intersection of traffic streams at more favorable angles.

6) Provision of refuge for vehicles waiting to initiate or complete a maneuver.

Let us look at examples illustrating each purpose of channelization separately. In each of the figures, it will be assumed that the north direction is toward the top of the page and that the east-west street is the major facility.

First, let us inspect various types of unchannelized intersections in order to see the areas in which the "conflict points" occur. Figures 1a and 1b illustrate intersections of two-way streets with and without signals, respectively. Figures 2a and 2b show one-way streets intersecting two-way streets with and without signals. A quick glance at Figure 1b shows the extremely short time in which a driver must make many decisions. In order to show the rapidity with which these decisions must be made, let us say the north-south street in Figure 1b is 50 ft. wide. A driver passing straight through the intersection on the east-west street encounters eight conflict points. If all eight points are within the 50-ft. width of the cross street, that is, within a 50 ft.-length of travel, and the driver is traveling at a speed of 30 mph (44 feet per second), then he will pass through the area in a time of $50/44 = 1.14$ seconds. During this time, he encounters a conflict point every $1.14/8 = 0.14$ second. This of course is an average value, as the points are not evenly spaced, but it does serve to illustrate the literally split-second judgment that a driver must be able to exercise in this typical situation.

Let us investigate the possibility of separating the conflict points in the typical unsignalized, four-way

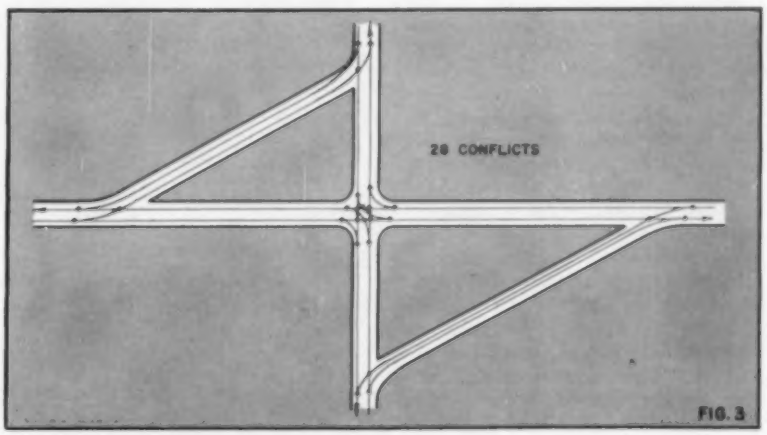


FIG. 3

intersection of Figure 1b. Here we have 32 conflict points. By installing the auxiliary lanes as shown in Figure 3, the conflict points for a driver making a left turn from any approach are reduced from six in number to four. More important, however, is the fact that the conflict points are dispersed. Another example is illustrated by the intersection shown in Figure 4a, a skewed T-intersection. Figure 4b shows how channelization not only has separated conflict points, but has also improved the formerly awkward turning paths from southbound to eastbound and from westbound to northbound Figure 4c is an even more elaborate scheme for the same situation.

Frequently, we desire to improve a particularly difficult turning maneuver, very often the left turn. A device that has been used is the 270° ramp for left turn movements as shown in Figure 5a. This arrangement has the disadvantage, however, of requiring a vehicle to pass through the intersection twice. Furthermore, the rotation of the vehicle through three quarters of a circle is confusing to drivers. A better solution might be the adoption of the plan shown in Figure 5b. where a vehicle desiring to make a left turn passes through the intersection, then turns into the "semi-direct" connection shown. This arrangement, however, while facilitating the eastbound to northbound turn. encourages drivers to make the illegal maneuvers shown so that they may avoid the intersection proper. Thus the congestion is not alleviated. but only relocated. We shall see later how this illegal turn problem can be eliminated. Both of these alternatives, along with the layout shown in Figure 3b, require great amounts of space and are generally not satisfactory for use in urban areas.

As stated previously, one of the purposes of channelization is the reduction of vast areas of pavement. When a number of wide roads intersect at a common point, there is a great deal of "open field runing" in which vehicles are not confined to definite paths. This causes driver confusion and accident hazard. Let us examine the intersection shown in Figure 6a. Here we have three 4-lane streets intersecting, creating perhaps as many as 50 conflict points in one area. Also, note that many of the maneuvers are somewhat awkward, involving almost a complete reversal of direction. Figure 6b shows a conceivable solution to the problem. This lay-

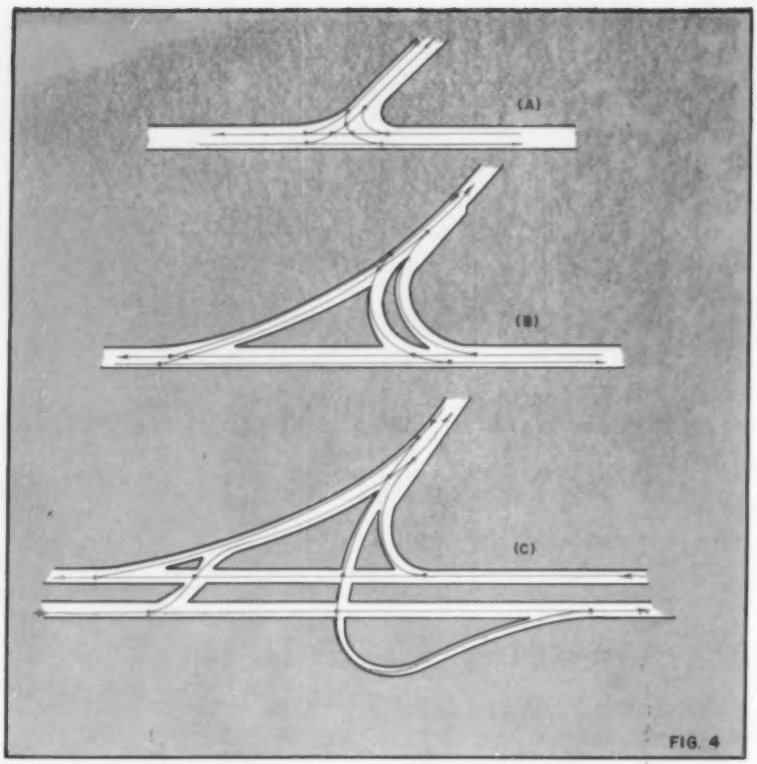


FIG. 4

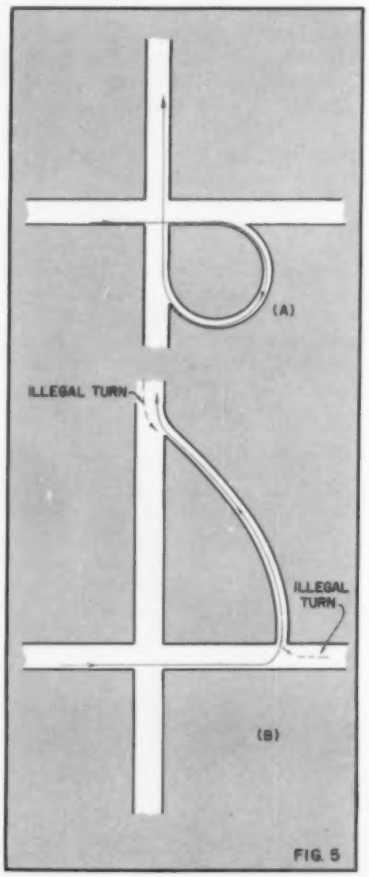


FIG. 5

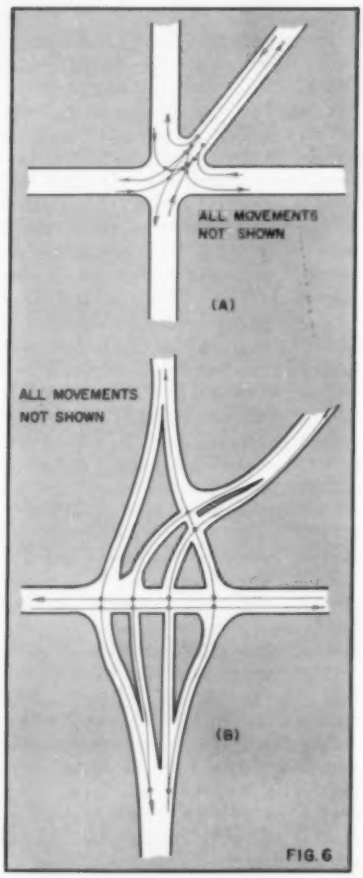


FIG. 6

out provides a definite path for each component of the total flow and more clearly delineates the path of travel to be taken.

One of the most important purposes of channelization is that of preventing wrong turns. Figures 7 and 8 show how this technique directs flow onto one-way streets. The plan in Figure 8, while discouraging northbound to eastbound and westbound to southbound turns, does cut down intersection capacity and might not be practical. Referring back to Figure 5b, recall the method proposed for improving a left turn maneuver. The connection has the disadvantage of attracting other maneuvers as indicated previously. If, however, the termini of the connection were modified as shown in Figure 9, these movements would be discouraged.

Another very important purpose of channelization from the standpoint of safety is the intersection of traffic streams at more favorable angles. A typical example is a three-way intersection in which the traffic streams meet obliquely. Experience has shown that a driver is better able to judge the speed of a vehicle traveling a path at right angles to him than at oblique angles. Furthermore, it is a distinct hazard for a driver to look back over his shoulder for approaching vehicles. An improved scheme is shown in Figure 10. Note that the minor approach which formerly was used for both directions of flow is now used only for those westbound vehicles executing the acute angle turn to the northwest. Note also the end treatment of the new connection which positively compels southeast bound vehicles to turn to the right and meet the major facility at a right angle.

Lastly, by channelization, storage for waiting vehicles is provided. Figure 11 illustrates how a wide median accomplishes this in a divided highway. Figure 4b, which was originally designed to separate points of conflict, also provides storage for vehicles turning left onto the major highway.

In discussing and illustrating various purposes and schemes of channelization, factors such as capacity, volumes, speeds, vehicular types and other traffic controls (signals, signs, etc.) have been ignored for clarity. It should be understood, however, that channelization is merely a tool in the hands of the engineer, which may be used only with careful evaluation of these other factors in the interests of safety, economy and efficiency.

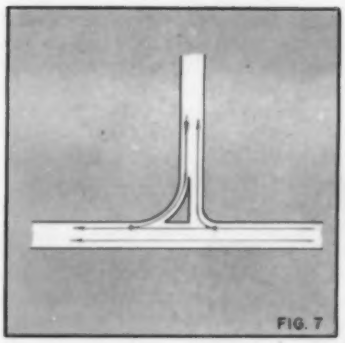


FIG. 7

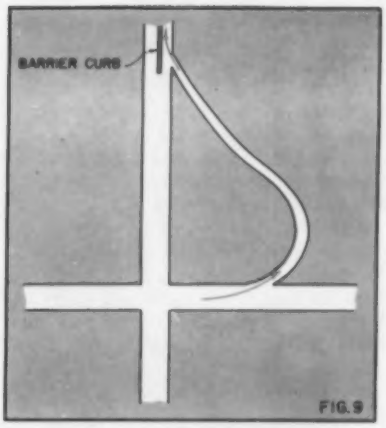


FIG. 9

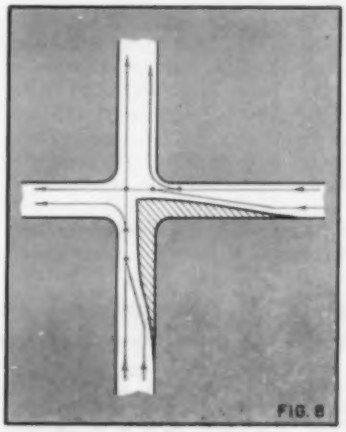


FIG. 8

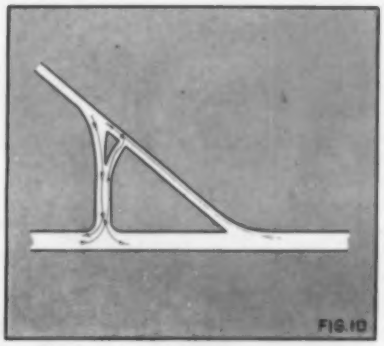
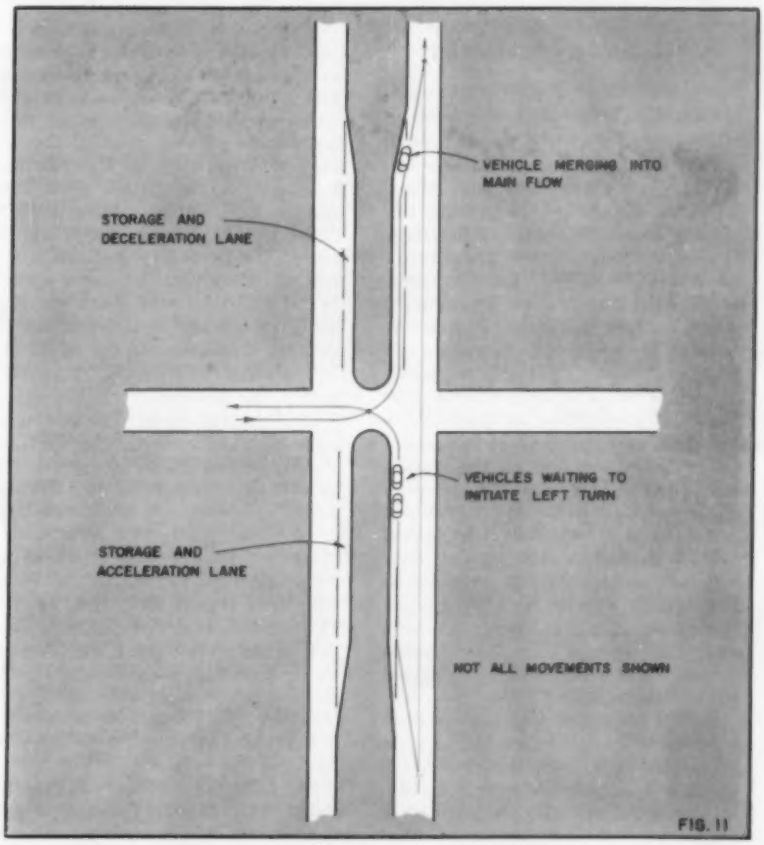
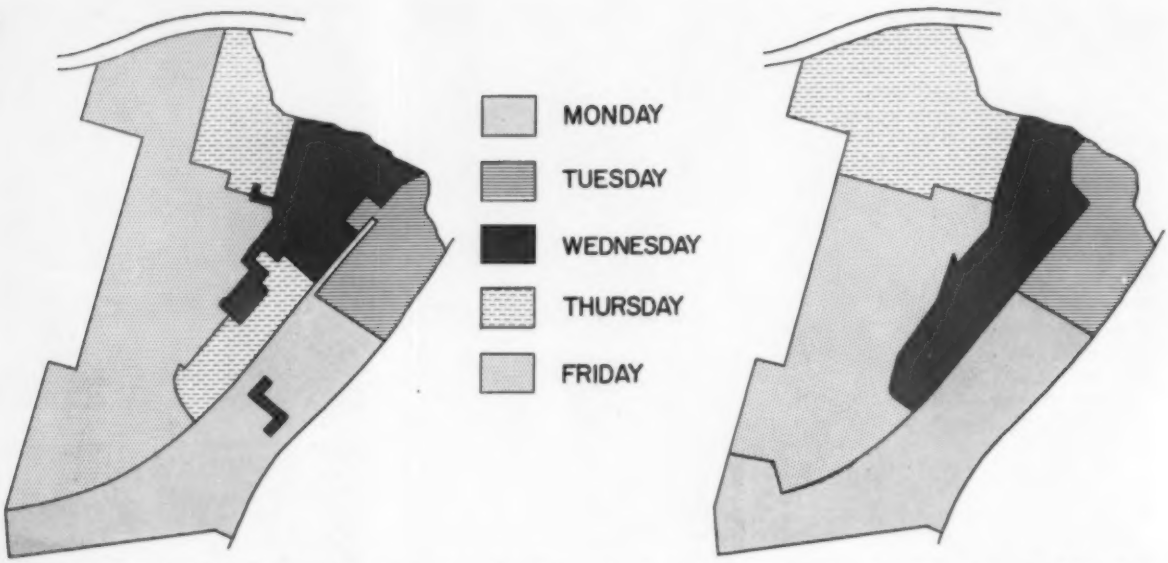


FIG. 10


VEHICLE MERGING INTO MAIN FLOW
STORAGE AND DECELERATION LANE
VEHICLES WAITING TO INITIATE LEFT TURN
STORAGE AND ACCELERATION LANE
NOT ALL MOVEMENTS SHOWN
FIG. 11



● COMPARISON of old and new collection districts show how routes have been made compact, with uniform servicing time.

REVISED COLLECTION ROUTES MEET SUBURBAN GROWTH

WILLIAM A. SOMMERS
Township Manager,
Franklin Township, New Jersey

IT IS necessary to introduce the story of revamping our refuse collection system by describing the population distribution in Franklin Township, New Jersey. The northeasterly extremity of the Township touches the city of New Brunswick, while to the southwest it extends as far as Princeton Township in Mercer County. Franklin is nearly 50 square miles in area with a 1960 recorded population of just under 20,000. Seventy percent of the population, however, live in the highly developed urban area that borders on Brunswick while the remainder is scattered throughout the highly rural areas and in some hamlets dating back to pre-revolutionary times. Franklin is within the highly complex New York metropolitan area and has shown the phenomenal growth characteristics of current suburban expansion.

Refuse collection had always been a problem for the people in Franklin who lived near New Brunswick for there were few full time private collectors, until recently. A number of residents therefore requested that the Franklin Township Committee set up a refuse collection district for taxing purposes in order to provide such service. The district as contemplated included most of the urbanized area next to New Brunswick and was designed with little thought of future growth. The Township Committee, early in 1948, passed the necessary ordinance and the collection district became a reality. The district was described precisely in the ordinance, and the financing was based on an additional *ad valorum* tax on all properties within the district.

At first the route was run on a half-time basis. With the addition of new homes the routes grew, and by 1959 the routing was on a five day week. once-a-week pick up, done by a three man crew operating a 16-cu. yd. packer body truck as the front line unit. An additional 16-cu. yd. truck served as a reserve unit. The operation of the refuse collection system was under the direction of a township committeeman who in addition to his public office held his own job, though he devoted as much time as possible to development of the system.

In 1958 the people of Franklin voted to adopt council-manager government which became effective on July 1, 1959. The welter of problems confronting the council was immense but the council directed the manager to study the refuse collection system as soon as possible in order to seek ways to improve its effectiveness and efficiency. A review of the system was started in the fall of 1959 with the aid of the Superintendent of Public Works, George Micklo.

A short review initially revealed a number of deficiencies. Under the committee system of township government each committeeman was assigned certain adminis rative departments for his oversight. But holding down his regular job and giving attention to the many problems of municipal administration was a burden for most committeemen. As the problems accelerated by growth increased, the committeemen became more and more engulfed in a myriad of administrative detail and, in many cases, could not control the operations assigned to them, though they were dedicated and capable. Consequently, there were no route maps of the collection system. no daily checkoff of stops and no real details on the collection operation and its efficiency.

To overcome this the Crew Chief was asked to describe the routes

as they had developed which were then roughed in on a map of the collection district. The first thing that became apparent was the fact that collections were being made outside of the tax district. With the advent of new subdivisions street patterns on the fringes were changing and the original lines of demarcation meant very little in the face of new additions. Also, the Crew Chief and his crew had very little specific knowledge of the boundaries of the district. As a consequence they merely continued collections as the new houses were added. Since the district was being financed from a special district tax levied only on those parties within the district lines, the problem was vital. To clarify the situation, the township engineer was ordered to stake out the district boundaries in the areas of confusion to determine the exact limits. In one new subdivision the line went through houses, separated neighbors and proved to be highly illogical and confusing to all concerned.

It was also determined that the district could not be expanded without a revision of the ordinance. This was further complicated by the fact that we were not sure that present operations could stand any further expansion, despite the obvious fact that many other residents not now in the district would want very much to be included. After proper discussion with the Township Council it was agreed that within a reasonable time those people now being served but who were not in the district would be cut off from the service. Sufficient advance publicity of this move was given and a letter was drafted explaining the situation, delivered one month in advance of the cut off date to the people affected. The move, of course, caused much comment on the part of the people who had been receiving service for a number of years from the municipality, albeit the service was actually free. The private collectors operating in the area were all notified of the cut off date and the people affected, thus giving the residents ample time and opportunity to make arrangements for new collections. Considering the move involved, the number of complaints were at a minimum.

It was clear, of course, from this experience that a much more detailed study of the whole operation would have to be undertaken. However, the Manager, the Public Works Superintendent, nor any of his foremen had sufficient time to undertake a complete, detailed examination and report. One day while talking to a group of Rutgers University students about council-manager government and the managerial profession, the author suggested that the Township was looking for a student who would like to get some on-the-job training at modest rates but with interesting problems. As a result we were fortunate to engage Frederick Mayer, a junior in political science and city planning whose schedule of studies made it possible for him to give sufficient time to the study.

Study Procedure

Our student planner was given an introduction to the Township and spent a few days with the Superintendent of Public Works getting briefed on the areas covered and the routes followed. An outline of the whole problem was given him by the Manager and a course of study decided upon. Armed with stop watch, maps, counters, etc., he followed the sanitation crew in one complete round of collections while at the same time charting out the route followed, the pick ups, the stops, the time intervals and general operational effectiveness. The sanitation crew was briefed on the student planner's function to make it clear that he had not been hired to spy on them but to get the detailed information so that improvements could be made. At the same time the employees were told that a normal working operation should be maintained and not a "speed-up" to impress the "Boss." From the results of the study, it was apparent that the workers and the student planner had a good relationship and all were able to give suggestions and discuss proposals so that in the end their interactions greatly aided the study.

The field work was conducted during the last of March, 1960, and a full written report, together with supporting data and maps, was submitted to the Manager in May. Most of the information was in the form of a tabulated day by day record of the time interval between stops.

On two days, the number of houses served at each stop as well as the total number of houses served were recorded. These figures were then compared with the total number of stops to obtain the average number of houses served per stop. A final tabulation gave a summary of the overall route.

Evaluation of Findings

From the study, a number of observations were made regarding the character and quality of the service. On the time consumption factor, the greatest single offender was the trip to the dump, made three times a day. The multiplicity of dead end streets, however, contributed much to the delay. There was little room for criticism of the men in this area; they worked well and efficiently. There was overlapping of routes and splintering (including part of one day's route in the middle of another day.)

A definite pattern for routing did not seem to exist from one week to the next. While the men appeared to use this freedom to the best advantage of the Township, it is a potential nuisance to the administrator. Routes were not necessarily contiguous and the location of the garage was not considered. It was felt that by applying sound principles, the efficiency of the route

Table 1—Summary of Time Study (Original Survey)

Duration of Pickups in Seconds (Selected at Random):

Monday		Tuesday	
20	65	46	35
28	70	25	52
50	40	45	50
40	80	18	49

Average stop: 40 to 45 sec.

Number of Stops per Day:

Monday	326
Tuesday	302
Wednesday	338
Thursday	357
Friday	305

Average Number of stops: 325.6

Average Number of Houses per Stop: 1.15

Table 2—Summary of the Restudy of Collection Routes

	Old Route	New Route
Monday		
Time	8 hrs.	7½ hrs.
Stops	326	404
Tuesday		
Time	7½ hrs.	6 hrs.
Stops	302	302
Wednesday		
Time	7 hrs.	7 hrs.
Stops	338	396
Thursday		
Time	7 hrs.	7 hrs.
Stops	357	396
Friday		
Time	9 hrs.	5½ hrs.
Stops	305	193

could be increased with a saving in time.

The recommendations developed in the report were substantially as follows:

1) A larger capacity truck should be obtained to permit a reduction in the number of trips to the dump from 3 to 2 per day and, consequently, to increase the time available for collections.

2) Splintering must be eliminated and contiguous, fairly compact, route districts set up.

3) A key to the fenced-in dump area should be left with the driver of the garbage truck to take care of late arrival.

4) Regulations governing the type of garbage accepted and the manner in which it should be set out, should be drawn up and distributed.

5) A general schedule should be established so that the administrator will know approximately where the truck should be at a particular time, and so that the crew will know what is expected of them.

6) All new housing in the service area should be recorded on the map and provided for in the routing, and regular restudies should be made to see if the efficiency of the route is being maintained and to prevent quality of service from dropping.

A detailed map was prepared to show the proposed rerouting. The districts were unified and the routine was modified to bring it as close to the standards of efficient routing as is possible within the confines imposed by the existing street system.

Revised Program

The results of the study were discussed with the Superintendent of Public Works and the Township Council and a program of implementation was evolved. First, the new routes as proposed by the planner were gone over in a "dry run" with the Crew Chief. Slight changes were made but the basic pattern was found to be workable and a considerable improvement. Next, the Council ordered specifications to be developed on a 20-cu. yd. packer with chassis and bids taken. After consultation with the manager and the superintendent of public works, the Township Council purchased a 20-cu. yd. Gar Wood packer to be mounted on a White chassis and traded in one of the 16-cu. yd. trucks. About the same time, the Council passed a comprehensive ordinance on refuse and sanitation collection, setting up rules and regulations for public and private collection operations.

By July, 1960 most of the preparations were complete. Our student planner was then asked to work up a brochure explaining the new routes and regulations, to be delivered to each customer on the route prior to the actual changeover. The date of July 25, 1960 was picked as the changeover time. The brochure included a map of the district, a general description of each day's routing, the rules of collection, the schedule affecting holidays, and throughout, attractive illustrations were effectively used. Advance notice of the changeover was given two weeks before the actual date and the local weekly paper printed the new map in full with each day's route clearly designated. About the same time the planner, armed with the brochures, followed the sanitation truck through its normal routing and delivered, door to door, a copy of the brochure so that we were sure the brochure had been delivered to the house without imposing on the working time of the sanitation crew.

July 25 came and went with only a minimum of questioning and two complaints. The switchboard operation, of course, had been thoroughly briefed on the new routing, had the new route map along with the other information contained in the brochure and thus calls were handled quickly.

However, even then the job was not quite completed. After the routes had been in effect for two months, our student planner was asked to restudy the routing and to compare it with his original study to see if the probabilities envisaged for the changeover had been achieved. The survey was made in the same manner as the original study and the results were submitted. The report summarized the effect of the study and results achieved as follows:

"In every case the comparison showed an increase in the efficiency of the operation after rerouting. This is due to the use of a newer, more efficient truck and to the consolidation of the pick-up areas brought about by the rerouting. The improved operation has left room in each day for expansion which will be necessitated by the construction of new housing in the township during the next few years. . . In attempting to summarize the results of this restudy, the following factors seem obvious. The men are handling more garbage in less time without any reduction in the number of homes being served. The overtime which was present in the first study, has been eliminated. Extra time has been provided in each day's route to allow for the eventual expansion of that route. Time for servicing and cleaning the truck has also been provided. The men themselves seem to be happier with the new routing. All in all, the objectives of the study and rerouting of the collection routes has been achieved. The new routing is giving Franklin Township an efficient and reliable collection service and it should continue to be a sound basis for collection in the immediate future."

● **THIS NEW 20-cu. yd. compaction type refuse collection vehicle was purchased after study recommended purchase of a larger capacity truck to increase efficiency of operations. Author (left) poses with public works superintendent George Micklo.**

STEPS IN PREPARING A 5-YEAR CAPITAL IMPROVEMENT PROGRAM

ERNEST B. BODNAR
Administrative Assistant,
City of Decatur, Illinois

AMERICAN communities find themselves challenged on all sides by problems of urban life—great population increases, urban sprawl, decay and functional obsolescence of older sections of the community, increased service demands, and transportation, drainage and water supply difficulties. Each of these communities has limited resources with which to relieve their problems.

An overall Community Capital Improvement Plan has been used with great success in several cities to meet the most important urban needs by systematic preparation. Such a plan is based on the improvement needs of each local government agency within its respective service area. After adoption, the overall plan is effected through a detailed long range capital budget for each local government agency. The advantages of this method are that it will:

Provide a review of all Capital Improvement projects as well as the methods to finance them. Such a review has the "built in" advantage of requiring careful study of the relationship between the community's needs, financial resources, and the ability to finance various projects.

Assure that projects will be undertaken in order of their need and that overlapping projects will be avoided.

Provide a reasonably accurate forecast of future demands on the community's revenue resources and borrowing power.

Facilitate the optimum use of such items as manpower, funds, equipment, and advanced right-of-way and property acquisitions.

In a June, 1960, report of the city manager to the city council, it was pointed out that during recent years, Decatur had taken some important strides forward in consciously preparing to meet future community needs. Studies and projects which were completed or undertaken by the city included:

1) Completion of a land use study and revision of the 1941 Zoning Ordinance in 1959.

2) Adoption of new platting and subdivision regulations including the addition of public improvement specifications in 1960.

3) Preparation of a major thoroughfare plan to serve as a basis for the city's street improvement program and state expenditures for federal and state routes in the Decatur urban area.

4) Completion of a comprehensive traffic improvement and parking facilities study in 1960 with the cooperation of the Downtown Council and Association of Commerce.

5) Approval in 1960 of the Decatur "Workable Program" for the elimination of blight and substandard housing, and approval of the preliminary plan and capital grant request for the first of seven proposed urban renewal projects.

6) Completion of a detailed condition analysis of all secondary and residential streets.

7) Completion of a three year program of water treatment facilities improvements and appointment of a Water Advisory Committee for the study of water supply and distribution reservoir capacity problems.

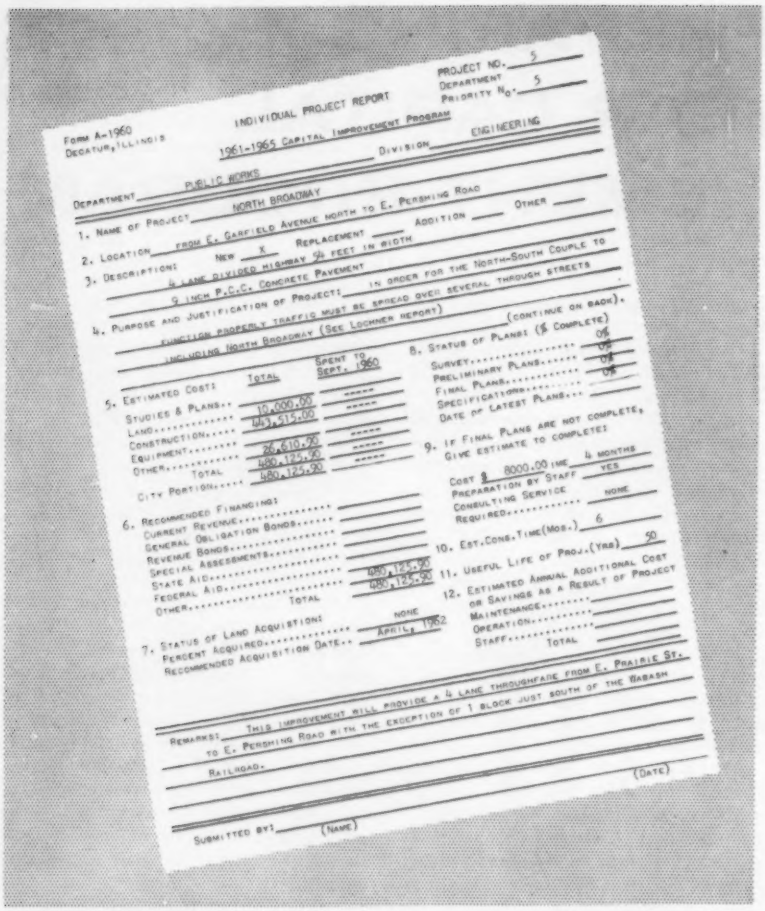
Over and above the progress made in these studies and projects, several other areas needed investigation. These included mass transportation, housing and facilities for the aged, storm water drainage and the need for a community center.

Other major governmental agencies in Decatur, notably the Park District and School District, co-ordinated their development plans with each other by agreeing on a plan for joint long range acquisition and construction of school and park facilities. The Decatur Sanitary District likewise had a long range improvement program which anticipated future extensions of sanitary sewers and treatment plant additions.

Despite the excellent progress made by the separate Decatur agencies in developing plans to meet future community needs within

Photos courtesy Decatur Herald and Review

● **GROWTH of Decatur in area and in population density necessitated increased allocation of funds to traffic facilities. This shows dedication of a new expressway.**



Form A-1960
Decatur, Illinois

INDIVIDUAL PROJECT REPORT
1961-1965 Capital Improvement Program

PROJECT NO. 5
DEPARTMENT
PRIORITY No. 5

DEPARTMENT PUBLIC WORKS DIVISION ENGINEERING

1. NAME OF PROJECT NORTH BROADWAY
2. LOCATION FROM E. GARFIELD AVENUE NORTH TO E. PERSHING ROAD
3. DESCRIPTION: New X REPLACEMENT ADDITION OTHER
4 LANE DIVIDED HIGHWAY 96 FEET IN WIDTH
9 INCH P.C.C. CONCRETE PAVEMENT
4. PURPOSE AND JUSTIFICATION OF PROJECT: IN ORDER FOR THE NORTH-SOUTH COUPLE TO FUNCTION PROPERLY TRAFFIC MUST BE SPREAD OVER SEVERAL THROUGH STREETS INCLUDING NORTH BROADWAY (See Lochner report)

5. ESTIMATED COST:

	Total	Spent to Sept. 1960
Studies & Plans	10,000.00	-----
Land	843,515.00	-----
Construction		-----
Equipment	26,610.92	-----
Other		-----
Total	480,125.92	-----
City Portion	480,125.92	

6. RECOMMENDED FINANCING:

Current Revenue	
General Obligation Bonds	
Revenue Bonds	
Special Assessments	
State Aid	480,125.92
Federal Aid	480,125.92
Other	
Total	

7. STATUS OF LAND ACQUISITION:
Percent Acquired NONE
Recommended Acquisition Date.. APRIL 1, 1962

8. STATUS OF PLANS ($ Complete) (continue on back).

Survey	0%
Preliminary Plans	0%
Final Plans	0%
Specifications	
Date of Latest Plans	

9. IF FINAL PLANS ARE NOT COMPLETE, GIVE ESTIMATE TO COMPLETE:
Cost $ 8000.00 Time 4 MONTHS
Preparation by Staff YES
Consulting Service NONE
Required

10. Est. Cons. Time (Mos.) 6
11. Useful Life of Proj. (Yrs) 50
12. Estimated Annual Additional Cost or Savings as a Result of Project
Maintenance
Operation
Staff
Total

REMARKS: THIS IMPROVEMENT WILL PROVIDE A 4 LANE THROUGHFARE FROM E. PRAIRIE ST. TO E. PERSHING ROAD WITH THE EXCEPTION OF 1 BLOCK JUST SOUTH OF THE WABASH RAILROAD.

SUBMITTED BY: (NAME) (DATE)

● **A TYPICAL individual project report. These reports provide complete information on each project included in Decatur's five-year capital improvement program.**

their respective service areas, no provision was made for an overall review of the proposed projects of all agencies in their relationship to each other, to the total of the community's revenue resources, and to future community revenue requirements. The need for such machinery is critical if the full benefits of Community Capital Improvement Planning are to be realized. Accordingly, the Plan Commission, which included representatives of the county, city, school district, park district and sanitary district, were directed by the City Council to request a list of proposed capital improvement projects from all agencies; establish a priority list of projects and schedule each to co-ordinate with other related or dependent projects; and propose a revenue program outline to finance the capital improvement needs in the future.

Program Manual

In August, 1960, the Planning Director prepared a detailed manual for distribution to all local government agencies. Its contents include an explanation of the purpose and scope of a five year (1961-1966) Community Capital Improvement Program, and a step-by-step procedure to establish a uniform method of presenting needed public improvements. Major features of the procedure which established standards for presenting projects included the following:

Projects to be Included: Items of large size, fixed nature, and a useful life of five years, such as for example; streets, sewers, watermains, buildings. All rolling stock regardless of the life of the item, such as fire trucks, automobiles, trucks, hi-lifts, graders.

Project Number and Priority. Each Agency or department head of an agency should list each project in numerical order prefixed by the agency or department's code letter. Projects should be arranged in numerical order in the order of priority. The major criteria for considering each project's relative importance are protection of life, maintenance of public health, provision of public service including convenience and comfort, protection of property and reduction of operating costs.

Project Description. Each project should be named and described in relation to existing facilities or proposed projects. The location should be in sufficient detail to permit spotting on a map. The description of the project should indicate whether the item is new, a replacement item, an addition to an existing project or the replacement of an existing project.

Purpose and Justification. Justification for the item should be detailed and related to the major criteria for establishing the project's relative priority. Justifications are to be supported wherever possible by reference to accepted standards, special reports, surveys and engineering studies.

Estimated Cost. Prevailing unit contract prices are to be used. Land costs are included only when additional purchases are necessary. Costs of plans and studies are to be included even though they are prepared by the agency or department. "Other Costs" are to cover supplementary construction necessary for a project. For example in the case of a building, provision for increased water supply, roadways, landscaping and site preparation.

Estimated Additional Cost or Savings. Agencies are to indicate the amount by which the annual operating budget may be increased or decreased due to the project or item. Maintenance cost should include heat, light, repairs, janitor service, etc. Staff costs should be included to indicate manpower requirements to operate the facility.

Source of Funds. All project costs can be met, and are to be accounted for, by any one or a combination of the following sources, for example: General fund revenues, bond issues, state or federal contributions, special fund revenues such as water, parking, motor fuels tax, etc.

To coordinate the work of the several departments, the planning manual provided a timetable for all steps in the program, including a deadline for the return of the departmental programs. Responsibility for supplying project data for improvements connected with more than one department was specifically assigned.

The Five-Year Capital Improvement Program

In January, 1961, the City completed its portion of the overall

1961-1966 Community Capital Improvement Program. The plan consisted of four sections, covering fundamental planning considerations, projections of operating expenditures and revenues, detailed improvement needs and methods to finance improvement needs.

Fundamental Planning Considerations. Studies of Decatur's economic base and recent trends in the City's development indicated that the City increased 91 percent in area and 17 percent in population over the past decade. Both the labor force and the number of employees engaged in manufacturing increased. In addition, overall employment was well distributed.

Industrial expansion during the 1950's was the prime generator of Decatur's growth. This also affected Decatur's position as a trade center. A 1960 study indicated that 22 percent of the persons who parked in downtown Decatur to shop lived in five surrounding counties.

The most significant trend in Decatur's development was its growth in area and the accompanying decrease in population density. A 43 percent increase in auto registrations has created the need to allocate more of the community's resources for street and highway maintenance and construction, traffic control facilities, and off-street parking. The increased service area of the city meant a heavier reliance on motor equipment to provide service and requires the relocation of existing fire stations and a complete area storm sewer-drainage study. In addition, rehabilitation and renewal of the older high population density areas is needed.

The available water supply will set the practical limits of future growth and development. Under existing use and supply conditions, Decatur's lake supply is sufficient to meet the community's needs in years of normal rainfall. Over the long term, an additional water supply impounding reservoir is needed.

Projected Operating Expenditures and Revenues. In making projections for operating funds from which capital improvements would be financed it was assumed that the cost of personal services would increase 4 percent during 1961 and 2 percent annually thereafter. For supplies, materials, and contractual services, a 2 percent increase per year was projected for the five-year period.

An individual approach was used in the projection of revenues from each existing source. These sources include general fund property taxes, sales tax receipts, sales of water, motor fuel tax receipts and the motor vehicle parking fund.

Detailed Improvement Needs. Improvement needs included on the 1961-1966 city program totaled $51.3 million. Of this amount $11.9 million would be the city's direct financial responsibility. Needed major improvement items included:

Water supply, treatment, and distribution improvements—$28.1 million. Provision is made for a second impounding reservoir estimated to double Decatur's water supply, acquiring a new water treatment plant site, a well field survey and installation of distribution mains.

Street improvements and traffic control facilities totaling $16 million. Provision is made for 17 street improvement projects and a new downtown traffic light system.

Off-street parking facilities in which 330 additional parking spaces will be provided—$500,000.

Urban renewal projects—$4.5 million providing for the completion of the area now approved and another to begin in 1963.

New fire stations, fire apparatus and motor equipment—$900,000.

Other improvements including new data processing equipment; police laboratory equipment; storm sewer, housing for the aged, and community center studies; and, improvements to city buildings—$1.3 million.

Financing Improvement Needs. This section analyzed the availability of projected revenues in excess of operating costs for each of the four operating funds from which capital improvements could be financed. It was determined that suitable bond issues would meet needs of the General Fund and the Parking Fund. Since available projected revenues in the Motor Fuel Tax Fund above previous operating commitments would not be sufficient to pay principal and interest charges on a bond issue of $5 million to finance needed street and highway projects, a careful study was made of each source of revenue which cities in Illinois are permitted to use. These included a cigarette machine license tax, a wheel tax and a utility tax.

● ONE OF the parking lots which will provide 330 additional off-street parking spaces at a cost of $500,000. This lot has both 3-hour and 1-hour parking meters.

Conclusion

Long ago Sophocles remarked—"Among the great things which man has taught himself are language, wind swift thought, and city dwelling habits." Certainly the highest of city dwelling habits which man has taught himself are the duties of a citizen and the arts of the City. These arts and habits of city dwelling do not remain fixed. They are constantly changing in response to the dynamic requirements of modern urban life. The Decatur Capital Improvement Program outlines a systematic program of city improvements needed for a growing, dynamic and vigorously expanding community. When co-ordinated with similar programs of other local government agencies, the citizens of Decatur will have a blueprint of what their City can be within the near future.

BASIC PRINCIPLES OF PAVEMENT DESIGN

E. J. YODER
Associate Professor of Highway Engineering and Research Engineer, Joint Highway Research Project, Purdue University

Part 3 – Flexible Pavements

Presented here is the final part of this series of articles. Part I dealt with the broad aspects of pavement design as affected by pavement performance under given conditions and pavement behavior under load. Part II presented the basic design principles applicable to rigid pavements. Fundamental considerations, soil classifications and pavement stresses were discussed along with current practices employed in structural design. A similar approach to the principles of flexible pavement design follows.

The material in this series of articles is based in part on the book by the author, *Principles of Pavement Design*, published by John Wiley and Sons, Inc., New York, 1959.

A FLEXIBLE PAVEMENT consists of a bituminous wearing surface built over a base course and subbase course, which rest upon the compacted subgrade. By definition, as used in this series of articles, the flexible pavement includes all components of the pavement above the compacted subgrade. Thus, the subbase, base, and wearing surface are the structural components of the pavement.

The essential difference between flexible and rigid pavements is the manner in which they distribute the load over the subgrade. The rigid pavement, because of its rigidity, tends to distribute the load over a relatively wide area of soil; thus, a major portion of the structural capacity is supplied by the slab itself. In contrast, the load carrying capacity of flexible pavements is brought about by the load distributing characteristics of the layered system. Flexible pavements consist of a series of layers with the highest quality materials at or near the surface. Hence, the strength of a flexible pavement is a result of building relatively thick layers and thereby distributing the load over the subgrade, rather than by the bending action of a slab. The design thickness of flexible pavements is influenced greatly by the strength of the subgrade.

PAVEMENT COMPONENTS

Ideally, a flexible pavement is built to such a depth that stresses on any given layer will not cause undue rutting, shoving, or other differential movements which may result in an uneven wearing surface. The chief function of the surfacing course is to provide a smooth wearing surface, resistant to traffic. However, the wearing course ought to provide some shearing resistance to the pavement base structure with added resistance to deformation. The wearing course should be watertight to prevent surface infiltration and subsequent weakening of the subgrade, and in addition, it should be flexible so that it will not fail if consolidation of the subgrade or base course takes place.

Because of the wide number of bituminous materials which are available for construction plus the flexibility of construction techniques, many types of bituminous surfaces can be built. The type of surface depends largely upon the load that will be applied to the pavement, as well as upon economics and availability of construction materials. The essential components of a bituminous wearing surface are the surface course and the binder course. The uppermost layer is the surface course and it is usually somewhat thinner than the lower binder course. In general, smaller aggregates and slightly more bitumen are incorporated in this layer than in the binder course.

The binder course is essentially a transitional layer between the base course and the surface course. A tack coat is applied at the interface of the surface and binder courses. A prime coat is used between the binder and base and a seal coat may be applied to the top of the surface course. Although an ideal pavement may consist of both a binder and surface course, many flexible pavements are built of only one layer.

The base course is the layer of granular material which lies immediately below the wearing surface, whereas the subbase is a layer of material between the base and subgrade. Since the base course lies close to the pavement surface, it must possess high resistance to deformation in order to withstand the high pressures imposed upon it. As a result, crushed materials are used quite often, and many times the base course is stabilized with cement or bitumen. Sometimes asphalt concrete base courses are used, while in other situations, penetration type bases are used.

Subbases for flexible pavements are generally made up of cheap, locally available materials. As a result, a variety of materials, including pit run sands and gravels, stabilized soil, and select borrow are often

used. The purpose of a subbase is to permit construction of relatively thick pavements at low cost; thus, the quality of subbases can vary within wide limits as long as the thickness design criteria are fulfilled.

STRESSES IN FLEXIBLE PAVEMENTS

Various theories are available which permit approximation of stresses in flexible pavements. Stress equations for flexible pavements are necessarily based upon several simplifying assumptions; however, they can be used to illustrate, at least in a qualitative sense, the relative effects of magnitude of loads, tire pressures, and wheel gear configuration on pavement thickness.

Stress equations most widely used are those developed from the basic Boussinesq stress equations. These equations apply to an ideal material which is perfectly elastic and homogeneous, and obeys Hooke's law. These equations have been extended by Dr. D. M. Burmister for application to layered systems (17).

Considering the Boussinesq theory, the distribution of vertical stresses below a concentrated load on any horizontal plane takes the form of a bell shaped surface. Maximum stresses occur on the vertical plane passing through the point of load application. The pressure is maximum at shallow depths, theoretically becoming zero at infinity. For practical considerations, stresses can be assumed to approach zero at a finite depth.

In the study of flexible pavements, the load at the surface is not a point load, but is distributed over an elliptical area. Pressures at the tire-pavement contact (assuming no tire effects) are equal to the tire pressure. Variation of stress with depth follows the same general pattern as for the point load case.

According to Boussinesq's formula, the vertical stress at any depth below the earth's surface due to a point load at the surface is as follows:

$$\sigma_z = k\,\frac{P}{z^2} \quad \ldots\ldots (15)$$

Where:

P = point load
z = depth
$k = \dfrac{3}{2\pi}\,\dfrac{1}{[1+(r/z)^2]^{5/2}}$
r = distance radially from point load

From equation 15 it is seen that the vertical stress is dependent upon the depth and radial distance and is independent of the properties of the transmitting medium.

Integrating Equation 15 over a circular area, the vertical stress on a plane passing through the center of the plate is as given in Equation 16. It should be noted that vertical stress decreases rapidly as depth increases.

$$\sigma_z = p\left[1-\frac{z^2}{(a^2+z^2)^{3/2}}\right] \ldots (16)$$

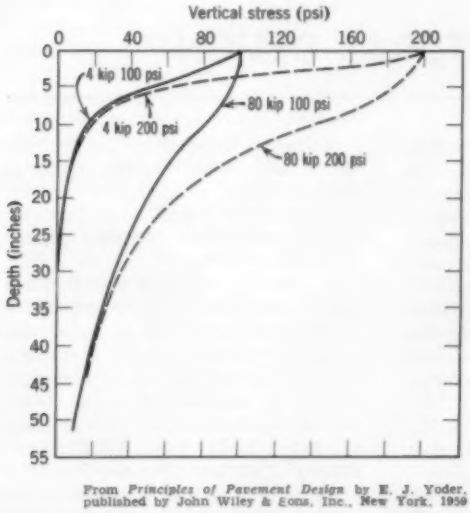
Where:

p = unit load
a = circular radius of contact

Equations 15 and 16 apply to homogeneous conditions. Since flexible pavements are layered systems, actual stresses in the pavement vary from theoretical stresses calculated according to Boussinesq. Solutions to the problem which approach actual conditions have been obtained by Burmister. In the solution of the two-layer problem, certain essential assumptions are made regarding boundary and continuity conditions. The materials in the layers are assumed to be homogeneous, isotopic, and elastic. The surface layer is assumed to be infinite in extent in the lateral direction, but of finite depth, whereas the underlying layer is infinite in both the horizontal and vertical directions. Stress and deflection values as obtained by Burmister are dependent upon the strength ratio of the layers.

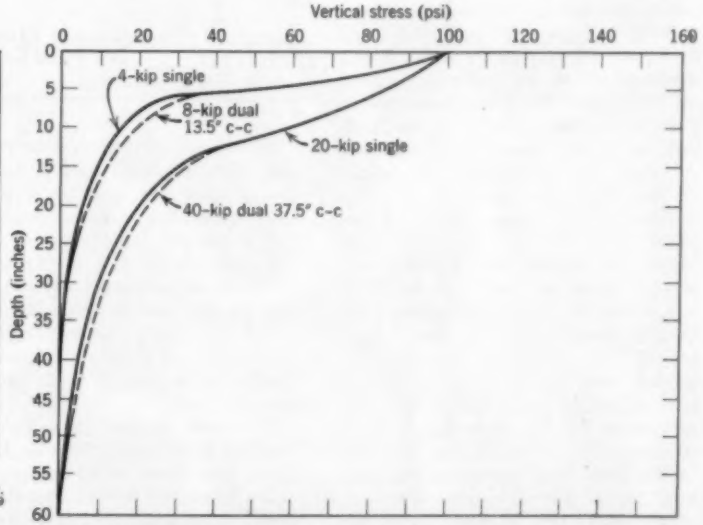
The effect of stiff reinforcing layers is pronounced. Tests have shown that for most cases, the Boussinesq equations result in stresses which are larger than the measured values. Calculated deflections also tend to be greater than measured values. Stress *patterns*, however, as determined by measurements in prototype pavements, are similar to the theoretical values as calculated using Equation 16 (18).

Since the stress patterns in prototype pavements are similar to the theoretical patterns (even though

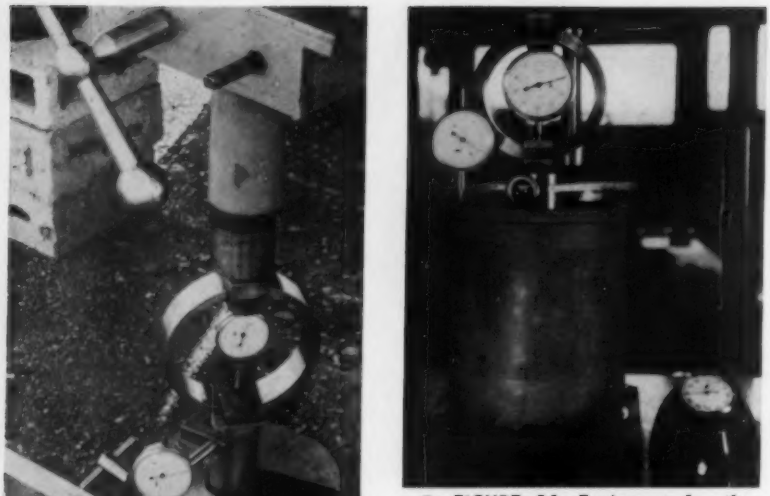


From *Principles of Pavement Design* by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1959

● **FIGURE 32. Variations of vertical stress with depth, using several types of tire load.**



● **FIGURE 33. Comparison of the effect of single and dual wheels on vertical stress in Boussinesq problem. All tires are inflated to 100 psi.**



● **FIGURE 34. Equipment for the California Bearing Ratio test in the field (left) and laboratory (right).**

actual stress values vary somewhat), this information can be used to good advantage to demonstrate the effect on stresses of tire pressure and loads. In particular, this information can be used to determine equivalency of loads. For example, the theory can be used to determine the magnitude of load on a dual wheel which will cause the same distress as a given load on a single wheel. This information is very useful in establishing design techniques.

The magnitude of vertical stress at a point in a soil mass due to a load at the surface will depend upon the applied pressure, as well as depth from the surface to the point. Figures 32 and 33 represent Boussinesq vertical pressures in an ideal soil mass due to various combinations of tire pressure and total load. In Figure 32, one curve is for a tire pressure of 100 psi and a gross load of 80,000 pounds. Also presented is a curve for an identical gross load, but for a tire pressure of 200 psi. As seen on the curves, the effect of the high tire pressure is pronounced in the upper layers of the pavement, whereas at a depth of about 36 inches, the stresses are about equal for both cases. High tire pressures, thus, necessitate high quality materials in the upper layers of the pavement, but the required total depth of pavement is not affected appreciably by tire pressures. On the other hand, for a constant tire pressure, an increase in the total load increases the vertical stress for all depths. For example, in Figure 32, considering the 100 psi curves, it is seen that at a depth of about 20 inches, stresses due to the 80 kip load are about 50 psi, whereas those for the 4 kip load are about 5 psi.

Figure 33 shows the effect of dual wheels on stresses for constant tire pressure. Calculated stresses at the surface are not affected by the wheel configuration and are equal to the applied tire pressure. Dual wheels, however, result in increased stresses at greater depths, as do tandem axles when the pressure bulbs of the tires overlap. It can therefore be demonstrated that allowable wheel loads cannot be doubled merely by adding another wheel close beside a single wheel.

According to Boussinesq, the stress at any point below an earth mass due to a circular loaded area is dependent only on three quantities. These are: 1) Depth, 2) radius, and 3) tire pressure. It can be shown that for loads of different magnitude (total) but of same tire pressure, the stress depends only on the ratio of the depth over radius of loaded area. This means that, for geometrically-similar points below the pavement surface and for a constant tire pressure, stresses are equal regardless of the total load. This information can be used to develop Equation 17.

$$z = K\sqrt{P} \quad \ldots\ldots\ldots (17)$$

Where:

z = depth for equal stresses
P = total load on a single tire

From this equation, the required depth of flexible pavement is equal to a constant times the square root of the total load. In Equation 17, K depends upon the allowable stress in the soil and tire pressure.

Most design methods for flexible pavements take the general form indicated in Equation 17. This necessitates, however, evaluation of the proportionality constant K.

As a result of the simplifying assumptions that must be made regarding stresses in flexible pavements, practically all methods of design in existence at the present time rely heavily on correlative procedures. This means that equations, for example, may be developed which take into account, insofar as possible, the variables which affect pavement thickness, but in the end it becomes necessary to correlate pavement performance with design test data.

STRUCTURAL DESIGN

At the outset it should be emphasized that although several different design methods are in existence; each method has been established for a specific case. Hence, direct comparisons of the methods cannot be made without some modification. In the final analysis, the validity of each design depends upon the correlation of design thickness and quality with actual field performance.

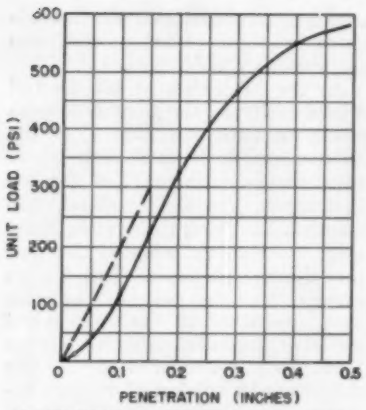
Pavement design procedures for flexible pavements can be broken down into three broad categories:

1) Empirical procedures that are based upon some arbitrary test value which has been correlated with pavement performance.

2) Design based upon soil classification and other factors such as climate.

3) Theoretical and semi-theoretical considerations utilizing proper correlation values.

Included in the first group is the use of the CBR for determining the strength properties of the subgrade, subbase, and base course materials. The test values are correlated with results of accelerated traffic tests, and/or performance of existing pavements under normal traffic conditions. Test data obtained from the plate bearing test and the cone bearing test have been used by some agencies in an empirical manner to obtain pavement thickness.



● **FIGURE 35. Method of transposing CBR curve to corrected values.**

The second group includes procedures currently in use by the Federal Aviation Agency and many state highway departments. For the FAA method, the soil is classified according to standard procedures, and then further regrouped according to frost action and ground water conditions. These data are used in an empirical manner based upon field performance. The group index, which is a part of HRB or AASHO classification method, has been adopted for design purposes by many state highway departments.

Included in the third group is the procedure that has been adopted by the United States Navy Department, which utilizes the plate bearing test for evaluating the modulus of elasticity of the subgrade and of the base course. In this procedure, the theoretical calculations are made using the Burmister techniques, and then proper adjustments are applied to fit the pavement design to anticipated field conditions.. Also included in this group is the use of the Boussinesq theoretical stress distribution and, in particular, the triaxial test to evaluate the stress-strain characteristics of the paving materials. This method has been adopted by the State Highway Department of Kansas for design of flexible highway pavements.

Regardless of the procedures used for the design of flexible pavements, the final criterion must always be based upon evaluation of pavement performance under actual field conditions. Many state highway departments. for example, have adopted coefficients which modify the basic design consideration. These coefficients are analogous to safety factors commonly used in structural design. Examples of the concept include the methods adopted in the states of Kansas and California. Likewise, the variation existing among CBR design curves in use by various agencies is primarily due to correlation constants which are used.

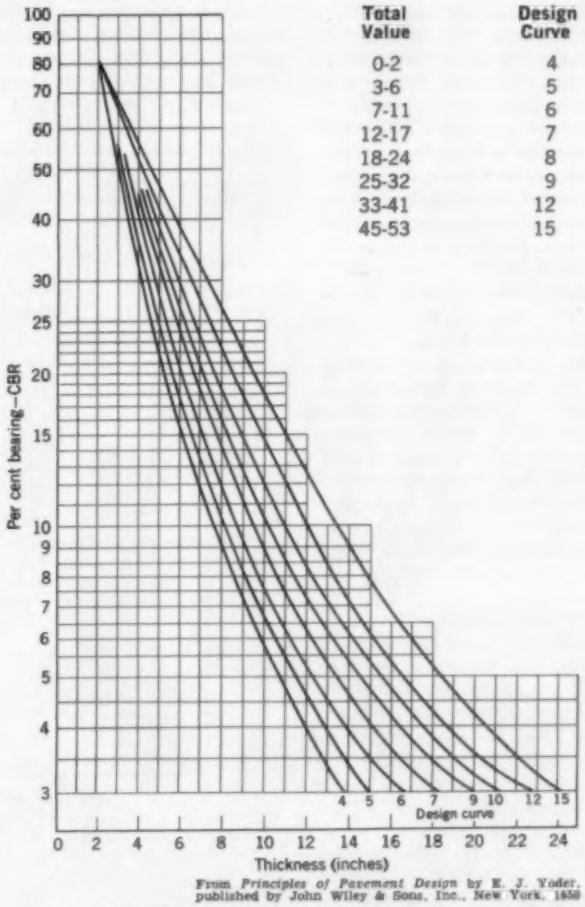
The California Division of Highways has developed a design chart that makes use of certain physical characteristics of the subgrade soil and the pavement or pavement base, as well as the applied load. In their procedure, a design equation has been developed which takes into account repetition of load, tire pressure, subgrade resistance and cohesion of the wearing surface (19).

Due to space limitations it will not be possible to discuss all methods of design that are currently in use. Emphasis will be placed in the following paragraphs on the California Bearing Ratio test and classification tests for design of flexible pavement thickness.

California Bearing Ratio Test and Design Method

The California Bearing Ratio Test is a penetration test wherein a standard piston having an end area of 3 sq. in. is caused to penetrate the soil at a standard rate of 0.05 in. per minute. The unit load at each 0.10-in. penetration up to 0.5 in. is recorded and the California Bearing Ratio is computed as the ratio of an arbitrarily selected unit load to that of a standard. The standard values were obtained by testing a high quality crushed stone; for 0.1-in. penetration it is 1,000 psi and at 0.2-in. penetration it is 1,500 psi.

Figure 34 shows a view of the laboratory and field equipment used for determining the California Bearing Ratio. The essential equipment consists of a piston, loading dial, and deflection dial. Surcharge weights, equal in weight to the anticipated pavement, are used during the performance of the test. The purpose of these surcharge weights is twofold. First, in the laboratory test, the sample is soaked in water for a period of four days so that the test sample will simulate field conditions after subgrade saturation. During the soaking period, some samples will swell, whereas others will not.



Total Value	Design Curve
0-2	4
3-6	5
7-11	6
12-17	7
18-24	8
25-32	9
33-41	12
45-53	15

From *Principles of Pavement Design* by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1959

(From Russell and Clinger, *Proceedings*, Highway Research Board, 1947)

● **FIGURE 36. Design curves used by the State of Wyoming.**

Table 13—Wyoming Design Factors*

Item	Limits	Value
Annual Precipitation	5-10 in.	0
	10-15 in.	1
	15-20 in.	3
	20-25 in.—light irrigation	6
	25-50 in.—heavy irrigation	10
Water table	None evident	0
	10-6 ft. below grade	1
	6-4 ft. below grade	3
	4-2 ft. below grade	5
Frost action	None	0
	Light	1
	Medium	3
	Heavy	8
Existing conditions	Excellent	0
	Fair	2
	Adverse	6
Traffic	0.0-1.0 million	0
	1.0-2.0 million	2
	2.0-3.0 million	4
	3.0-5.0 million	6
	etc.	
	15.0 plus million	24

*From Russel and Olinger, *Proceedings*, Highway Research Board, 1947

The amount a soil swells depends upon soil type and upon the restraining action of the surcharge weights (pavement in the field). The second reason for using surcharge weights is to prevent upheavel around the piston during the penetration portion of the test.

The unit load generally taken for design is 0.1 in. penetration; however, in some cases other penetration values are used. As a general rule, the CBR will decrease as penetration increases. In some cases, however, the value at 0.2 in. penetration may be higher than at 0.1 in. penetration. If this happens, the value at 0.2 in. penetration is used.

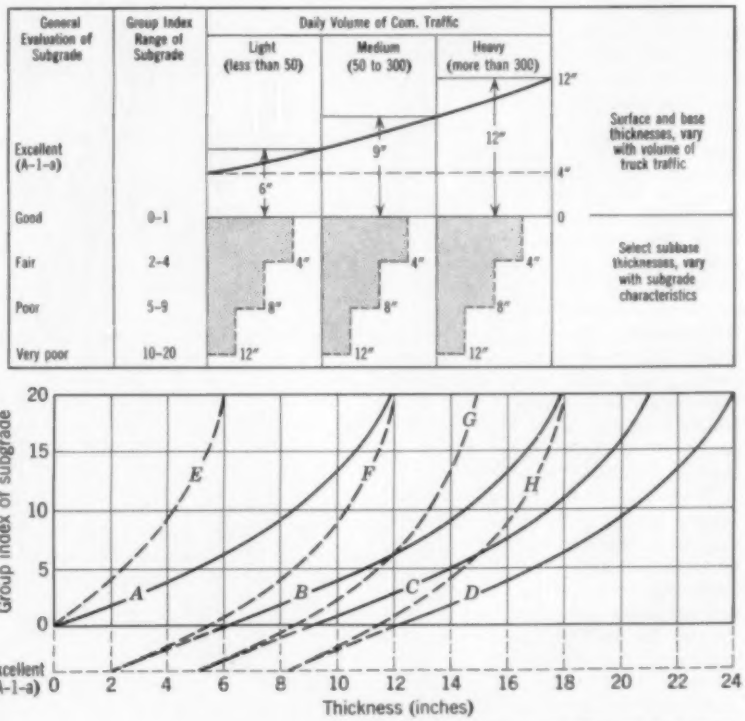
Reference is made, in performing this test, to corrected CBR values. The corrected value is obtained by shifting the CBR curve (if necessary) to the left so that it will pass through the origin to account for surface irregularities, non-perpendicular piston and uneven rate of load application. Figure 35 illustrates how the corrected CBR is obtained.

The CBR test is extremely sensitive to molding moisture content and density, and therefore, extreme care must be taken in fabricating the laboratory samples. In addition, the test is valid for shear deformation and, thus, its usefulness for testing certain types of materials such as cement stabilized soil is limited.

The CBR method of design was first used by the California Division of Highways as a result of surveys made during the years 1928 and 1929. CBR tests were performed on a large number of typical crusher-run materials which were considered representative of base course materials. The average of these test results, then, was designated CBR 100 percent. Samples of soil from failed and from satisfactory pavements were tested, and design curves were developed which indicated required pavement thickness for various CBR values.

At the beginning of the Second World War, the Corps of Engineers made an extensive survey of the different methods of flexible pavement design. As a result of this investigation, the CBR method was adopted. Likewise, many state highway departments adopted the test for design purposes. The design curves used by various agencies vary somewhat in that they yield different thickness values for a given CBR. This is due primarily, to the difference in opinion of various individuals regarding ultimate design performance of the pavement. Nevertheless, each CBR curve is used in an identical manner, and thus, to illustrate the use of the curves, it makes little difference which curves are used for this purpose.

Figure 36 shows the design curves used in the state of Wyoming[89]. The design curves give the thickness of pavement required above a material with a certain CBR. For example, assuming that a subgrade has a design CBR of 3 percent, and assuming that design curve 15 is the appropriate curve, a thickness of 24 in. of pavement is



From *Principles of Pavement Design* by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1959

(From Steele, *Proceedings*, Highway Research Board, 1945)

● **FIGURE 37. Suggested thickness requirements based on the Group Index chart.**

Table 14—FAA Subgrade Classes for Flexible Pavements

	Subgrade Class			
	Good Drainage		Poor Drainage	
Soil Group	*No Frost*	*Severe Frost*	*No Frost*	*Severe Frost*
E-1	Fa	Fa	Fa	Fa
E-2	Fa	Fa	F1	F2
E-3	F1	F1	F2	F2
E-4	F1	F1	F2	F3
E-5	F1	F2	F3	F4
E-6	F2	F3	F4	F5
E-7	F3	F4	F5	F6
E-8	F4	F5	F6	F7
E-9	F5	F6	F7	F8
E-10	F5	F6	F7	F8
E-11	F6	F7	F8	F9
E-12	F7	F8	F9	F10
E-13	Not suitable for subgrade			

indicated. If, in this example, a subbase material is available which has a design CBR of 26 percent, the thickness required above this is about 8 in. Assuming further that a base course material with a CBR of 80 percent is available, 2 inches of surfacing is required. Thus, the design thickness of a pavement for this case would be 2 in. of bituminous surfacing, 6 in. of 80 CBR base course, and 16 in. of CBR 26 subbase, making the total pavement thickness of 24 in.

In the Wyoming method, the design technique takes into account annual precipitation, depth to water table, frost action, existing conditions at the site, and traffic. Each of the factors is rated as indicated in Table 13. The sum of the appropriate rating numbers is used to choose a design curve. Annual precipitation determined from weather stations throughout the state varies between 5 and 50 in. per year. The water table factor is determined from the depth below finished grade to any known water table. Frost action values are determined in a qualitative manner from nearby roads in similar situations. If only slight heaving is observed, frost action is considered to be light. Traffic is determined by utilizing the equivalent wheel load techniques discussed in Part I of this series of articles. Only wheel loads of 4500 pounds or more are used in the computation.

The data shown in Figure 36 are used for illustrative purposes only. Other state highway departments have similar curves developed to fit their particular conditions. The Corps of Engineers has developed curves to fit a variety of conditions as they exist on airfields. Design curves used by the Corps of Engineers take into account traffic area (channelized and non-channelized areas), wheel configuration, tire pressure, and gross wheel load[22].

Soil Classification Methods

In a discussion of the paper on soil classification by the Highway Research Board method, Steele presented suggested thickness requirements on the basis of the Group Index,[23]. Figure 37 shows correlation data from this discussion.

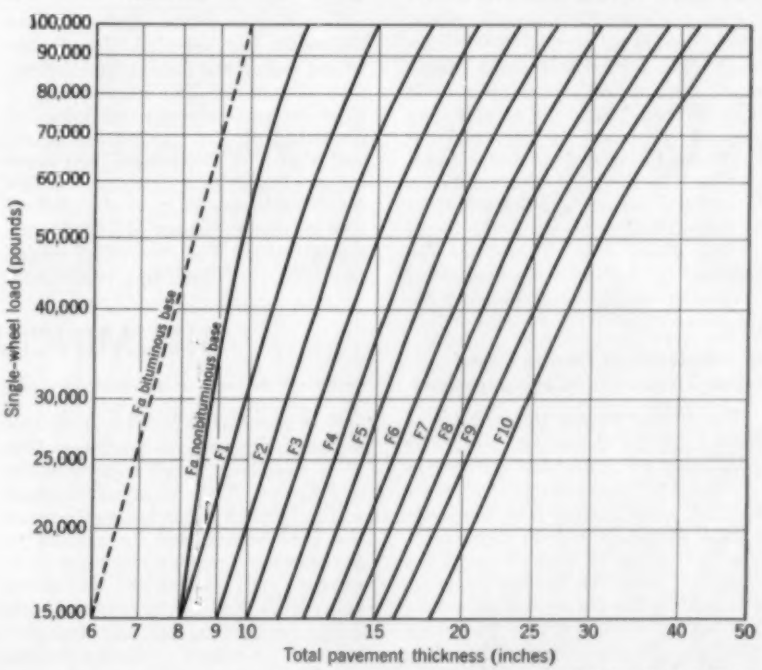
The Group Index is determined for each soil and the appropriate design thickness is determined from the figure. This method has been adopted by many states primarily because of its simplicity. The Group Index of a soil depends upon its liquid limit, plastic limit, and percentage of material passing a No. 200 mesh sieve[23].

The limitations of this procedure should be apparent in that such factors as moisture and density of the subgrade are not taken into account. It is assumed that soils with identical classification numbers give identical strengths after compaction in the field. Therefore, it is essential that compaction and construction specifications be rigidly adhered to at all times. Soils with identical classification symbols can vary within wide limits. Thus, in some cases, an overdesigned pavement may result.

Civilian airports within the United States are designed in accordance with the FAA standards. The FAA method of design is based upon soil classification. Subgrade soils are classified as to groups as indicated in Table 14. For design purposes, the subgrades are grouped according to drainage and frost conditions at the site[24].

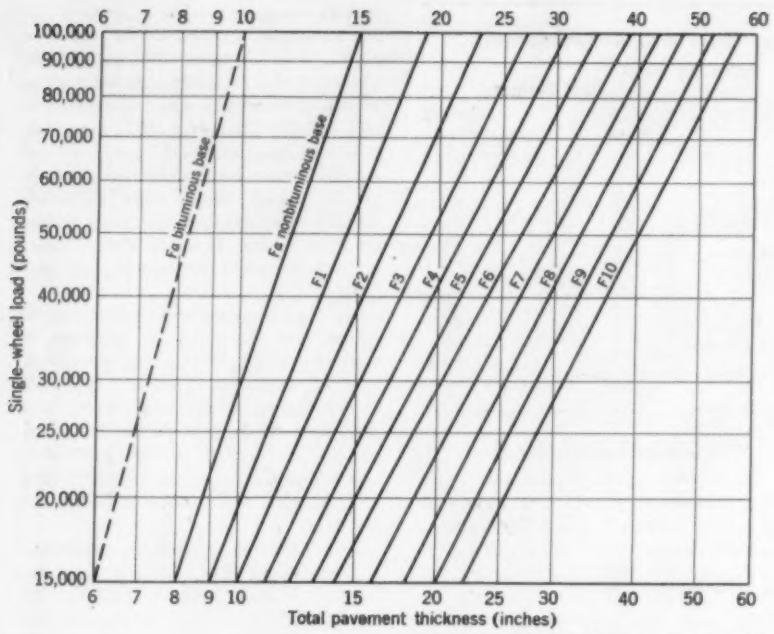
Poor drainage is defined as a condition where the subgrade may be rendered unsuitable owing to: 1) Inadequate internal drainage, caused by the character of the soil profile; 2) capillary rise from a high water table; 3) topographic features such as a flat terrain at elevations only slightly above water table; or 4) any other cause that may result in instability or produce saturation of the subgrade.

Severe frost is assumed to exist at the airfield if the depth of frost penetration is greater than the total depth of pavement. Depth to antici-



From *Principles of Pavement Design* by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1959

● **FIGURE 38. FAA design curves for flexible pavements—taxiways, aprons, etc.**



From *Principles of Pavement Design* by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1959

● **FIGURE 39. FAA design curves, flexible pavements, non-critical runway areas.**

pated frost can be estimated by means of data appearing in Part I of this series of articles, or from correlation data presented by the FAA.

Figures 38, 39, and 40 show the FAA design curves. These are based upon single wheels. Different design curves are used for the non-critical areas (the center portion of the runway) than for critical areas (taxiways, runway ends and aprons). It is to be noted that the total thickness of pavement is governed by total wheel load and subgrade classification. In contrast, the thickness of surface course and base course is determined only upon the basis of the wheel load. Therefore, the subbase is the only component of pavement which is influenced by subgrade type.

Methods of Design Based Upon Theoretical Considerations

The United States Department of Navy uses the theoretical equations developed by Burmister for design of flexible pavements. In their method, plate bearing tests are made on the subgrade and on some arbitrary thickness of base course. Data obtained from the testing program are used in the theoretical equations to estimate required pavement thickness for the anticipated loading conditions. The calculated thickness is checked by testing trial sections of the design pavement. Trial sections of pavement are built using the calculated thickness and other thicknesses slightly greater and slightly less than the calculated. The true pavement thickness, then, is that obtained on the basis of the trial sections for the critical deflection.

The Kansas State Highway Department has adopted the Boussinesq equations for design of flexible pavements. The triaxial test is used to evaluate the modulus of elasticity of the paving materials and then the theoretical equations are used to calculate required pavement thickness to limit the deflection of the pavement to certain assigned values. The theoretical thickness is modified by coefficients which take into account traffic and rainfall.

McLeod Method

The McLeod method for determining the required thickness of flexible pavements was developed from the results of plate bearing tests made on runways at Canadian airports [8].

Tests were made on the surface, base course, and subgrade at a large number of test locations. For the plate bearing tests, a repetitive load test procedure was employed. The test data were then used to develop Equation 18 which relates total pavement thickness with total load and subgrade support.

$$T = K \log \frac{P}{S} \quad \ldots\ldots (18)$$

Where:

P = design wheel load

S = subgrade support as determined by the plate bearing test

The proportionality constant K appearing in Equation 18, was evaluated from the plate test data and its value was found to vary with the size of the bearing plate. Using the basic equation, Dr. Norman McLeod developed design curves to fit a variety of conditions for design of both highway and airport pavements.

Hveem Stabilometer Method

The California Division of Highways uses a design method which takes into account repetition of load, tire pressures and resistance of the paving materials to deformation. The test procedure for evaluating subgrade resistance is such that the resistance to deformation is expressed as a function of the ratio of the transmitted lateral pressure on a sample to that of the applied vertical pressure. This information is then used in a design equation to obtain appropriate thickness values.

BITUMINOUS SURFACES

It is possible to build a wide variety of bituminous surfaces that give excellent service on flexible pavements. The type of surface which is used depends largely upon the load which will be applied to the pavement, as well as upon economics and availability of materials. High type pavements are generally built using hot mix asphaltic concrete surfaces, whereas pavements which carry lesser amounts of traffic may be built using less expensive surfaces.

Two types of bituminous materials can be used for roadway and runway construction. They are asphalts and tars. Asphalts either occur as such in nature or are manufactured from materials that occur in nature. For example, many natural rock asphalts are available, or asphalt can be produced by distillation of petroleum.

Asphalts, as they are commonly used, are obtained by distillation of petroleum. When a petroleum is subjected to a process of fractional

distillation, slow curing asphalts are among the products produced. Further distillation results in asphalt cements. Asphaltic cements are treated to obtain cutback and emulsified asphalts. Cutback asphalts are designated RC and MC for rapid curing and medium curing materials. The RC materials contain solvents which are more volatile than those in MC materials.

Types of asphaltic surfaces have been categorized according to the primary method of construction. A surface treatment is a low cost surface which is constructed by applying a layer of asphalt which is in turn covered with aggregate. Thicknesses may vary between ½ and ¾ in. Generally, surface treatments are less than one inch thick. They may consist of single, double, or triple layers.

Road mix bituminous surfaces are used quite frequently for secondary and primary roads. A road mix surface is mixed in place by means of traveling plants or conventional construction equipment such as motor graders, etc. Untreated stabilized gravel surfaces can be scarified and converted into road mix surfaces.

Penetration macadam has been used for surfaces as well as base courses. Construction techniques include the placing of crushed stone materials and then penetrating these with cutback asphalts or hot asphaltic cement. The primary requirement is that the asphaltic material should be highly liquid so that it can penetrate between the stone particles.

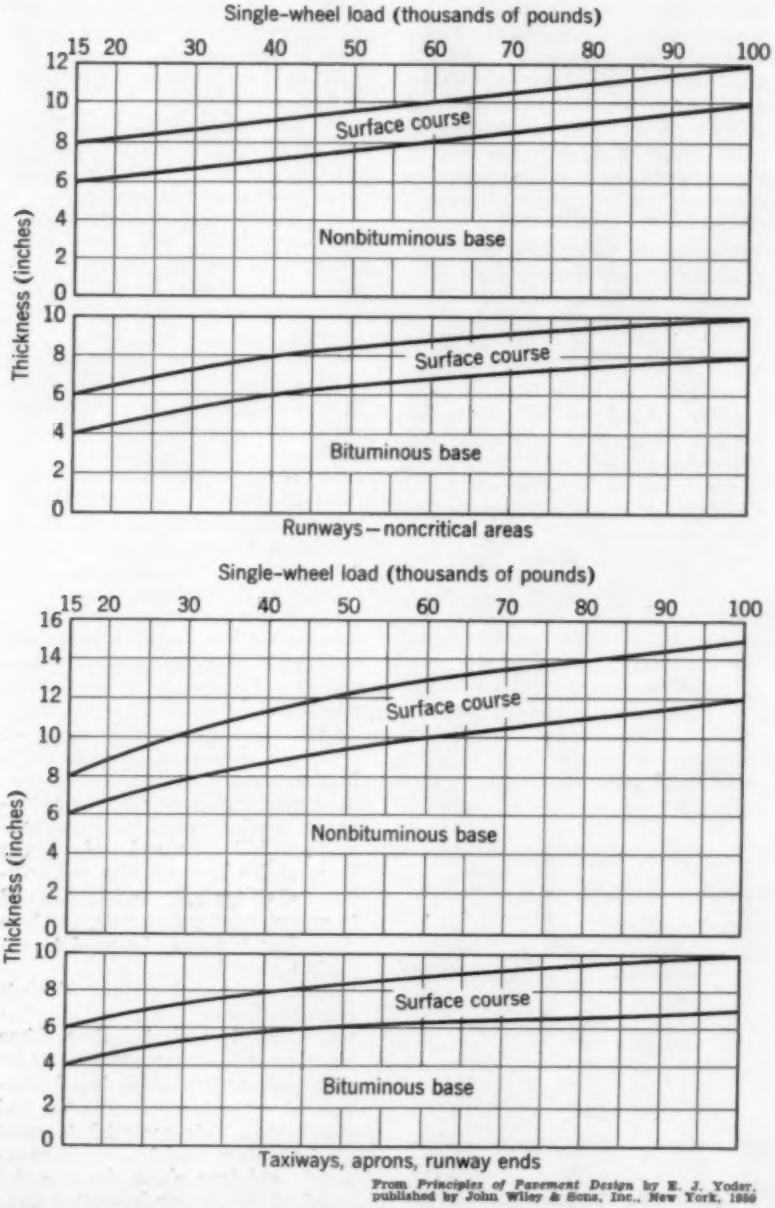
High-type asphaltic concrete pavements are used where high loads are anticipated on highways with high traffic volumes. The paving surface consists of a binder course and a surface course, with the necessary prime, tack, and seal coats.

The stability of bituminous concrete is made up of both cohesion and internal friction. Cohesion and internal friction in turn depend on gradation of the aggregate, density of the mix, and quantity of asphalt.

Since stability depends upon cohesion and internal friction, it is a function of density and quantity of asphalt. A thorough study must be made of the optimum amount of bituminous material for proper stability. In general, the greatest amount of asphalt that can be used without "over-filling" the voids is desirable. If the asphaltic concrete contains an insufficient amount of asphalt, it is likely to be nonresistant to abrasion of tires. On the other hand, an excessive amount of asphalt may cause flushing or bleeding and a subsequent slippery surface.

Several methods are available for evaluating the stability of asphaltic concrete. The Marshall method has been widely adopted, and is applicable to both highway and airport pavements[m].

In the Marshall method of design, specimens of the aggregate and bituminous mix are contacted in the laboratory, utilizing varying amounts of asphalt. The flow value, which is the deformation in hundredths of inches under the specified loading technique, is determined and the stability, which is the load put on the specimen, is also determined. The density values are calculated before test and computations are made of the total voids in the mixture and the percent of the aggregate voids filled with asphalt. Typical test results are shown in Figure 41. It is noted in Figure 41a that maximum density is indicated at a certain bituminous content. On the left side of the graph, the bituminous material coats the aggregate, whereas at the peak, the voids between the grains are essentially full and on the right hand side of the curve the aggregate is embedded in bi-



From *Principles of Pavement Design* by E. J. Yoder, published by John Wiley & Sons, Inc., New York, 1959

● **FIGURE 40. FAA design curves for thickness of surface course and base course.**

tuminous material. Likewise, s.ability increases a small amount (Fig. 41d) with increases in bitumen content to the optimum bitumen content and then decreases rapidly. The voids filled show an increase up to the optimum bitumen content, and then may show a slight decrease. Flow value (which is deformation) increases with percent of bitumen. The preliminary bitumen content for design is taken as the average of the peaks of the curves shown in Fig. 41.

Final design of the bituminous concrete then is accomplished by compacting specimens using this quantity of bituminous material and then making certain that they fulfill certain design criteria. Stability requirements for highways range between 300 for sheet asphalt to as high as 1500 for heavy traffic roads. The Corps of Engineers requires stability of 500 or greater for 100 psi tire pressures and 1800 or greater for 200 psi tire pressures.

SUBGRADES

The design of subgrades for flexible pavements essentially follows the same procedure as that discussed in Part II under design of subgrades for rigid pavements. One major difference is that since the thickness of flexible pavements depends so greatly upon subgrade strength, compaction and moisture content specifications should be built around pavement thickness based upon economics of materials versus the cost of compaction. Since stability is closely allied to density and moisture content, variable strength can be expected depending upon the degree of compaction. Thus, the design takes the form of investigating the stability and compaction characteristics of the subgrade and weighing these against cost of materials and cost of construction.

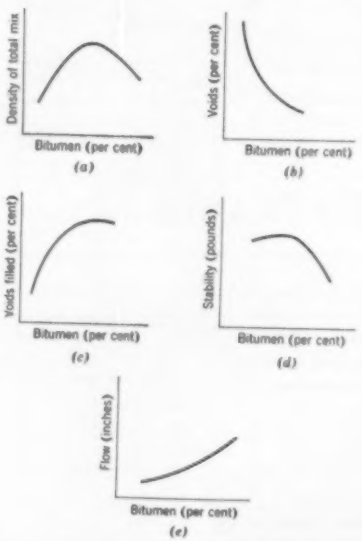
The concept of testing soils at their anticipated future moisture and density should always be the governing criterion. If past experience has indicated that a soil at a particular site can be compacted economically only to relatively low densities, it would be unwise to perform the design tests at some higher density value. It is imperative to make certain by adequate inspection during construction that the design densities and compaction moisture contents are fulfilled.

Another factor that must be given careful consideration is that of design values for various soil areas. A highway, unlike an airport, is likely to cross several basic soil types. Thus, it becomes necessary to assign different test values to each soil group. This can be done only if the engineer understands to the fullest the concept of soil formation. A subsurface exploration program should always be carried out to determine the basic soils over which the highway will cross and to evaluate each of the soils in order to select the most economical highway design.

Particular attention should be paid to soft organic and other unsuitable subgrades. These materials should be removed or else special provision should be made to consolidate them, and in some cases to compensate for low strength by increasing the thickness of the pavement. Potential frost-heaving soil should always be given special consideration. Isolated pockets of silt may be removed in some cases to permit the use of the standard cross sections.

Soil Stabilization

A problem continually facing an engineer is that dealing with procedures and techniques by which otherwise unsuitable soils may be improved by stabilization. In some instances, subgrade soils that are unsatisfactory in their natural state can be altered by admixtures or by the addition of aggregate and thus made suitable for highways and airport subgrade construction. In its broadest sense, soil stabilization implies improvement of soil so that it can be used for subbases, bases, and in some rare instances, surface courses. As in all engineering design problems, the economics of construction in light of the benefits derived from the stabilization process will determine whether it is warranted.



● **FIGURE 41. Configuration of typical Marshall test data curves.**

Soil stabilization is most widely used in flexible pavements; however, in some locations stabilized soils are used for subgrades under rigid pavements. Since flexible pavements derive their load supporting capacities by distributing the load down through a finite thickness of pavement so that pressures on the subgrade are not exceeded, stabilization which imparts additional strength to the subgrade can be beneficial. Likewise, improvement of borderline subbase material and relatively low quality base course materials has its place in stabilization.

Types of stabilization can be categorized as follows:

1) **Cementing materials.** These impart strength to the soil and result in increased stability under most weather conditions.

2) **Modifiers.** These materials are not intended to add appreciable strength to the soil, but are used merely to modify borderline and otherwise unsuitable soils and gravels.

3) **Waterproofing agents.** These include bituminous materials of all types and in some cases membranes which are used to encase the subgrade.

4) **Water retaining agents.** This category includes calcium chloride and sodium chloride, and is beneficial from the standpoint of laying dust, aiding in compaction, and permitting traffic binding.

5) **Water retarding chemicals.** These materials do not prevent absorption of water, but impart hydrophobic properties to a soil, which minimizes absorption of moisture.

One of the principal materials used as a cementing agent is Portland cement. Portland cement has been used with great success to improve existing gravel roads, as well as to stabilize natural soil. It can be used for base courses and subbases of all types. It can best be used in granular soils, silty soils, and lean clays, but it cannot be used in organic materials.

Another cementing agent which is often used, particularly in the southern states, is hydrated lime. Lime increases soil strength primarily by pozzolanic action, which is a formation of cementaceous silicates and aluminates. This material is most efficient when used in granular materials and lean clays, the quantity required for proper hydration generally being relatively low.

Fly ash, a material which is high in silicate and alumina, is sometimes used in conjunction with lime stabilization to speed the pozzolanic action.

The principal factor which affects the amount of cementing agent is soil type. It is necessary in this type of stabilization to compact the soil to relatively high densities; addition of cementing materials does not preclude good construction practices.

Borderline material such as some pitrun sands and gravels that contain excessive fine fractions can sometimes be made satisfactory for road construction by the addition of small amounts of Portland cement or lime. These materials alter the clay minerals of the soil making them less plastic. Additions of as little as one percent of either of these stabilizers will often decrease the soils plasticity so that the soil will perform satisfactorily at least as a subgrade.

Stabilization with cutback asphalts, road tars, and asphalt emulsions is satisfactory for coarse grained or granular soils, but its use for stabilizing extremely plastic soils is limited. Stabilization with bituminous materials involves waterproofing the soil in order to maintain the inherent strength of the stabilized material under all conditions of weathering. It is essential that all the inherent strength of the stabilized soil be utilized to its utmost, so that the waterproofing process will result in appreciable gains in strength over that of the natural unstabilized soil after subsequent saturation. The amount of bituminous material required for stabilization is generally relatively low, in the neighborhood of 3 to 5 percent.

Bituminous stabilization should not be confused with sand-asphalt mixtures which are sometimes used for base courses. For the latter case, the mixes are designed much as bituminous concrete is designed and the principal action is cementation and strength.

Calcium chloride and sodium chloride have been used as dust palliatives on improved road surfaces for many years. The reaction of the chloride in soil is brought about in large by changes in the soil water itself. Thus, the beneficial effects of salts are realized by decreasing the rate of evaporation of soil water and by lowering the freezing point of the water.

Many miscellaneous chemicals are available for stabilization which impart water-retarding characteristics to the soil so that they become hydrophobic. They are generally used in very small quantities, often as low as ½ percent by weight, and as a result mixing during construction is a serious problem. Use of these chemicals is generally restricted to isolated and special conditions.

In the final analysis, the choice of the admixture to be used will depend upon economics. The first question that should be answered by the engineer is, "Should stabilization be attempted at all?" In some cases it may be economical merely to increase the compaction requirements or, as a minimum, to resort to increased pavement thickness. If the engineer considers the mechanics of stabilization, it is possible to determine whether stabilization should be attempted and what types should be used. Many of the miscellaneous admixtures will not impart sufficient strength to a soil to make their use justifiable unless they are available at low cost and in large quantities at a particular location. Even though some means of stabilization is indicated, the use of a stabilizing agent cannot be a substitute for proper drainage of the roadway, proper utilization of ditches, compaction, and sound construction practices.

BASES AND SUBBASES

A primary property that a base course for a flexible pavement should possess is high stability. The stability of a soil-aggregate mixture depends upon particle size distribution, particle shape, relative density, internal friction, and cohesion. Of these factors, the size distribution of the aggregate, particularly the proportion of the fine to the coarse fraction is extremely important. An aggregate which contains little or no fines and is well graded, gains its stability from grain to grain contact. An aggregate which contains sufficient fines to fill all the voids between the aggregate grains will still gain its strength from grain to grain contact, but with increased resistance against deformation. At the other extreme is a material which contains a great amount of fines, has no grain-to-grain contact and the aggregate merely floats in the soil fraction. It should be apparent from the above that the stability of a soil-aggregate mixture is dependent upon the size distribution of the particles.

Table 15 shows the AASHO grading requirements for soil-aggregate mixtures. Types A and C have been used with considerable success in various parts of the country. Control of the amount of fines is very essential. The base course should not have a plasticity index greater than about 6 percent to insure stability when saturated.

Macadam base courses have been used successfully in various parts of the world. The term *macadam* indicates a base course or road surface consisting of crushed material to which is added, during construction, stone screenings which are then worked down into the mass. Macadam base courses may be designated as *dry bound macadam, water bound macadam,* or *penetration macadam,* depending upon the method of construction used. Dry bound macadam denotes a crushed aggregate base course, which gains its grain interlock through rolling or vibration. Water bound macadam indicates that water is added after the addition of fines and then the en-

Table 15—AASHO Grading Requirements for Soil-Aggregate Mixtures

	Per Cent by Weight Passing Square Mesh Sieves					
Sieve Designation	*Grading A*	*Grading B*	*Grading C*	*Grading D*	*Grading E*	*Grading F*
2 in.	100	100				
1 in.		75-95	100	100	100	100
⅜ in.	30-65	40-75	50-85	60-100		
No. 4	25-55	30-60	35-65	50-85	55-100	70-100
No. 10	15-40	20-45	25-50	40-70	40-100	55-100
No. 40	8-20	15-30	15-30	25-45	20-50	30-70
No. 200	2-8	5-20	5-15	10-25	6-20	8-25

1. Coarse aggregate shall have a percentage of wear by the Los Angeles test of not more than 50 per cent.
2. Fraction passing No. 200 sieve shall not be greater than two-thirds of fraction passing No. 40.
3. Fraction passing No. 40 sieve shall have liquid limit not greater than 25 per cent and a plasticity index not greater than 6 per cent.

tire mass is rolled. Stability is gained by grain interlock, as well as by some cementation of the fine fraction. Penetration macadam indicates that bituminous materials are sprayed over the stone and permitted to penetrate into the mass.

Macadam base courses gain their strength primarily from grain interlock as well as from the use of optimum fines. The decision of whether to use a macadam base course or a soil-aggregate base course should be based on economics. In areas where aggregates are quarried and crushed, or in locations where slag is readily available, macadam base courses are competitive with soil-aggregate materials. However, in glaciated areas, and in some of the coastal plains states, the abundance of natural gravel and sand deposits precludes the use of macadam bases.

Generally, a free draining base course with provision for adequate subdrainage is to be recommended. However, in some cases cost may preclude the use of a drainable material. In these cases, drains are not used, but the design includes high densification of the base and the base may be constructed in a trench.

The base course for a flexible pavement must be of good quality to prevent failure due to high stress concentrations immediately under the surface of the pavement. For this reason, the minimum CBR that is generally permitted is 80 percent. The Corps of Engineers requires a CBR value of 100 percent for base courses used in areas of heavy traffic. If inferior materials are used in the base, this must be compensated for by increasing the thickness of the wearing surface.

Subbases may consist of select materials such as natural gravels that are stable but that have characteristics which make them not completely suitable as base courses. They may also be of stabilized soil or merely select borrow.

The purpose of the subbase is to permit the building of relatively thick pavements at low cost; thus, the quality of subbases can vary within wide limits so long as the design thickness criteria are fulfilled. Density and moisture requirements can be determined by laboratory and field design tests.

To insure adequate stability, base and subbase materials must be compacted to a high density. For soil aggregate mixtures of all types, moisture control is extremely important. Relatively clean aggregates should be compacted in a near-saturated condition. Granular base course materials may be compacted in lifts ranging up to 6 to 8 in., depending upon the type of compaction equipment. If smooth-wheel compactors are used, the lifts should be controlled to about 4 in. However, if vibratory compactors are used, lifts of up to 8 in. are permitted. Field experience has indicated that compaction of base course materials to densities in excess of the modified AASHO values is quite common when vibrating compactors are used.

PAVEMENT STRENGTHENING

If a pavement becomes unduly rough, resurfacing and strengthening may be required. Maintenance procedures used on flexible pavements include periodic sealing, patching and resurfacing. It is necessary to seal the surface of many pavements to minimize surface infiltration of water, improve the anti-skid characteristics of the surface, and in some cases, to restore a smooth riding surface.

Before maintenance of a bituminous surface is accomplished, the cause of any pavement distress should be determined and then the defect corrected before patching is attempted. If bad groundwater conditions exist, the water should be intercepted and removed or else deterioration may again take place. Likewise, if small areas of unsuitable subgrade exist, they should be removed and replaced with suitable granular material.

Non-skid treatments are necessary when slippery or slick spots develop under the polishing action of traffic or from excessive bitumen in the pavement surface. Skid-proofing may be accomplished by application of a seal and stone chips and by resurfacing.

If it is necessary to provide an overlay on an existing pavement, the thickness requirements can be determined with ease by assigning appropriate design values to the subgrade. The CBR or other design tests will determine the required thickness of pavement. The difference between the required thickness and existing thickness is the amount of overlay to be added. Dense graded plant mixes can be assumed to have a CBR of 80 percent or more.

The FFA specifies that one inch of dense graded plant mix is equivalent to 1½ in. of base course. Thus, the required pavement thickness can be reduced if the thickness of existing surface course is taken into account.

Summary

Previous paragraphs have indicated in brief some of the principles involved in design of flexible pavements. Since the subgrade influences the required thickness of flexible pavements to such a large extent, it is necessary to carry out an adequate subsurface exploration program to insure that proper design data are assigned to the subgrade. It is necessary to compact all subgrades, subbases, base courses, and surface courses to make certain that all of the inherent strengths of the materials are used to advantage.

Several methods of design are available, each having its own particular use for given areas and for a given set of conditions. Thicknesses required by the various methods differ somewhat, due primarily to the factor of assigning ultimate criteria to the pavement.

Footnotes

17. Burmister, D. M., "The Theory of Stresses and Displacements in Layered Systems and Application to the Design of Airport Runways," *Proceedings, Highway Research Board*, 1943.
18. McMahon, T. F. and Yoder, E. J., "Development of a Pressure Sensitive Cell and Model Studies of Pressures in a Flexible Pavement Subgrade," *Proceedings*, Highway Research Board, 1960.
19. Hveem, F. N. and Carmany, R. M., "The Factors Underlying a Rational Design of Pavements," *Proceedings*, Highway Research Board, 1948.
20. Russell, I. E. and Olinger, E. J., "Wyoming Method of Flexible Pavement Design," *Proceedings*, Highway Research Board, 1947.
21. Corps of Engineers, "Engineering and Design, Flexible Pavements," EM 110-45-302, 1958, Waterways Experiment Station, *Technical Report 3-475*, February 1958.
22. Steele, D. J., "Application of the Classification and Group Index in Estimating Desirable Subbase and Total Thickness," (a discussion), *Proceedings*, Highway Research Board 1945.
23. "Report of Committee on Classification of Materials for Subgrades and Granular Type Roads," *Proceedings*, Highway Research Board, Vol. 25, 1945.
24. Civil Aeronautics Administration, "Airport Paving," U. S. Government Printing Office, 1956, also see Part II of this series of articles for method of classification.
25. McLeod, Norman W., "Flexible Pavement Thickness Requirements," *Proceedings*, The Association of Asphalt Paving Technologists, 1956.

Vacuum Loader Speeds Street Cleaning

WILLIAM J. RHEINFRANK
Superintendent, Bureau of Street Sanitation, Department of Public Works, Milwaukee, Wisconsin

LIKE MANY OTHER cities, Milwaukee uses conventional power sweepers of the dumping type in keeping city streets clean. This means that all sweepings collected and dumped by our 10 night and 7 day brooms, must be loaded and hauled to landfill sites. This formerly diverted one or more trucks every morning from each of the 20 non-combustible waste collection districts throughout the city. Crews hand loaded the broom dumpings into trucks and then returned to their regular waste collection routes.

In 1959, we purchased two "Vac-All" high pressure type vacuum machines from the Central Engineering Co., Inc. of Milwaukee, and have just concluded our second successful year of picking up all of our night broom sweepings with these machines. They are completely self contained units performing the operations of self loading, high speed hauling and dumping. Because trucks or additional men are not required, this equipment eliminates the necessity of coordinating men and trucks (with the resultant morning scramble of pick-up crews) and allows these crews instead, to concentrate their efforts upon their regular waste collection routes. A considerable saving on truck and labor time for broom pick-up has been effected since the inception of the program. The two units handle the output of 10 night power brooms from late March until the start of the October leaf pick-up. At that time they are diverted to specific leaf pick-up work and remain in a district until the completion of the leaf job.

The units "swallow" just about anything the brooms pick up including bottles, cans, good sized stones and even bricks, without damage to the equipment. Each vacuum machine operates with a 3-man crew consisting of a driver and 2 helpers. The broom dump locations are divided daily between the two units and loads are discharged at the nearest choice of six landfill sites. The "Vac-All's" have picked up, hauled and dumped up to 88 cubic yards and traveled as many as 50 miles in a single day.

In the spring both units are assigned to the emptying of 1300 ice-control sand boxes (approx. 1 cu. yd. each). The powerful suction is capable of emptying a full box in less than three minutes. With running time between boxes plus trips to dumping locations, each unit can empty about 40 boxes each per day. Hand emptying of the boxes had always been a tedious and costly job requiring heavy labor.

The vacuum operation is dust free, an important item when working in residential areas. At the top of the body there are 8 permanent filter assemblies which can easily be removed and cleaned. The vacuum street cleaner consists of a fully-enclosed, self-contained heavy duty body in which a high vacuum is maintained. The material enters the body directly without passing through the blower. The material is picked up by means of a 12-in. diameter flexible rubber intake hose which is spring-suspended from a top revolving support boom. The hose assembly can be easily moved in a few seconds and fastened to any one of five body connections. There are two connections on each side and one at the rear. The body load is dumed through a top-hinged one piece rear door. For raising the body a 28-ton capacity twin-cylinder body hoist is used. Vacuum is maintained by a high pressure type blower which is driven by a 6 cylinder industrial engine.

The use of the vacuum street cleaners has greatly simplified the operation of picking up and disposing of broom sweepings in Milwaukee while contributing to an increase in efficiency and over-all economy of operation.

Costs for Pickup of Broom Dumpings

Year	Pick-Up (Cu. Yds.)	Hrs. Worked	Average Cu. Yd/Hr.	Total Cost (1)	Ave. Cost Per Cu. Yd.(2)
1958 (3)	...	...	...	...	$7.17
1959	9,112	1,982	4.59	$23,784	$2.61
1960	13,460	2,403	5.60	$28,836	$2.14

(1) Vehicle and crews including travel time.
(2) Collection and disposal.
(3) Hand pickup by rubbish collection crews.

● **SPECIAL springtime use of the vacuum machines is emptying sand from the 1300 ice control boxes used in Milwaukee. This avoids costly and laborious hand work.**

Monitoring the LOWER MISSISSIPPI

JOHN E. TRYGG
Director,
Division of Public Health Engineering,
Louisiana State Board of Health

This article is based on a paper presented at a joint meeting of the Engineering and Sanitation Section, APHA and Conferences of Municipal Public Health Engineers and State Sanitary Engineers in November, 1960.

THE ONLY practicable source of water supply for the 10 southeastern parishes of Louisiana is the Mississippi River. About one million people in the area are served by 31 water supplies. The quality of the raw water permits production of generally acceptable water after treatment. An adverse factor is the considerable ocean-going traffic on the river as far up as Baton Rouge, 125 miles above New Orleans and 230 up from the Gulf. In addition to the potential pollution from this traffic, there are many industries along the river which discharge wastes into it. Normally the river water can be handled by the water treatment plants but occasional chemical spills may create serious problems.

After studying these chemical waste problems, it was felt that many of them could be minimized by timely warnings to water plants below the point of discharge. One problem arose from the fact that the flow of the Mississippi is somewhat laminar in nature and a stratification may exist with the result that some water plants are affected by a polluting discharge while others, even adjacent plants, may not be affected at all.

The accidental discharge, early in 1960, of 18 tons of phenol affected seriously many plants, especially the New Orleans system, and also many industries. For instance several tons of candy and a large volume of soft drink products, produced in New Orleans, had to be wasted. Following this occurrence, plans were made to prevent or minimize further troubles of this nature.

The Louisiana Stream Control Commission took positive action by calling the industries together and making them responsible for reporting immediately to the executive secretary any unusual discharge that might occur. The secretary in turn would pass this information on to the State Board of Health. The industry was also required to notify the immediate downstream water plants from their discharge in case of such an accident.

The Division of Public Health Engineering of the Louisiana State Board of Health devised a complementary plan to that of the Stream Control Commission in the form of a warning network with the personnel of the water plants and the personnel of the Board of Health as the principal participants. It was felt that, in order to be effective, any plan would have to be simple enough to minimize mistakes and to make participation by all levels of waterworks operators possible. It would also have to be workable within the physical facilities available. The plan could not be so demanding that apathy would develop after an extended period of no problems.

The plan as developed was based on the idea that all the various water plants along the River would act as monitoring stations in their routine operation, principally through the voices of their consumers. Even though technicians have the means to detect various substances in water, there is no means so effective as the consumers' palates in determining that something is wrong. Normal methods of communication would be used in transmitting information between all concerned.

After the basic plan was developed, a geographical listing of the water supplies using the Mississippi River was made starting at the uppermost plant at the Public Health Service Hospital at Carville approximately 38 miles below Baton Rouge.

Officials of all water plants concerned were contacted by telephone or personal visit to determine if they would participate in a warning network of this general nature. Although in some instances the replies were non-committal, and in one case no reply was received, there was no objection.

The Plan

The formal plan was then developed and was distributed in memorandum form to water agencies essentially as follows:

"Recent experiences of almost complete deterioration of Mississippi River water quality from the taste and odor standpoint due to accidental discharges by industry have indicated the need for a warning system so that all water plants can take precautions to produce the best water possible in case of such discharge. It appears that a warning system with the participation of water works people, the State Board of Health, the Stream Control Commission and industries can be developed to provide a reasonable safeguard to the quality of water going to consumers.

"This memorandum sets up the specific procedures to be followed and provides a listing of the responsible people to be contacted in case of reported discharges. This warning network will also fit in well with Civil Defense thinking, planning and functioning.

"It is proposed that the system will work as follows:

"1. If a water plant operator becomes aware of a deterioration in the quality of his raw water either by his personal observation or by telephone calls from consumers using the finished water, he will immediately call the State Board of Health Engineering Division personnel in the order provided on a separate sheet. It will be necessary to contact only one of the State Board of Health personnel but they should be called in the order as indicated in the Appendix referred to.

"2. The Board of Health engineer, on receiving the telephone call, will advise the downstream plants of the situation, beginning with the first downstream and then successively downstream until all have been called. When the downstream plants

have been alerted he will begin with those upstream. The names and addresses of responsible water works personnel are given in an Appendix to the memorandum, by plant according to their location on the River beginning with the Public Health Service Hospital plant at Carville and proceeding downstream.

"3. The Board of Health Engineers, on receiving a report of something unusual in the river affecting the quality of the water will begin an investigation as to the source of the pollution and will also advise the Stream Control Commission.

"4. It is anticipated that industry will be the source of information in most cases of accidental discharge and that they will advise the Stream Control Commission, or representatives of the Engineering Division of the State Board of Health. At the same time, under the Stream Control Commission plan, the industry will call water plants immediately downstream from the point of discharge. Information received by the Engineering Division direct from an industry or otherwise will be handled in the same manner as information obtained direct from water plants."

After completing the plan, it was published by the Board of Health and distributed to all the participants. Local newspapers assisted in publicity and the idea was favorably received by waterworks personnel, governing bodies and the consumers.

Results

This plan has been in effect since June, 1960, and although there have not been discharges in the magnitude of the phenol discharge previously described there have been some discharges and the warning system has worked excellently.

The velocity of the Mississippi in the New Orleans-Baton Rouge area is about 2 miles per hour (3 fps) at low flows and 4.8 to 5.5 mph at high flows.

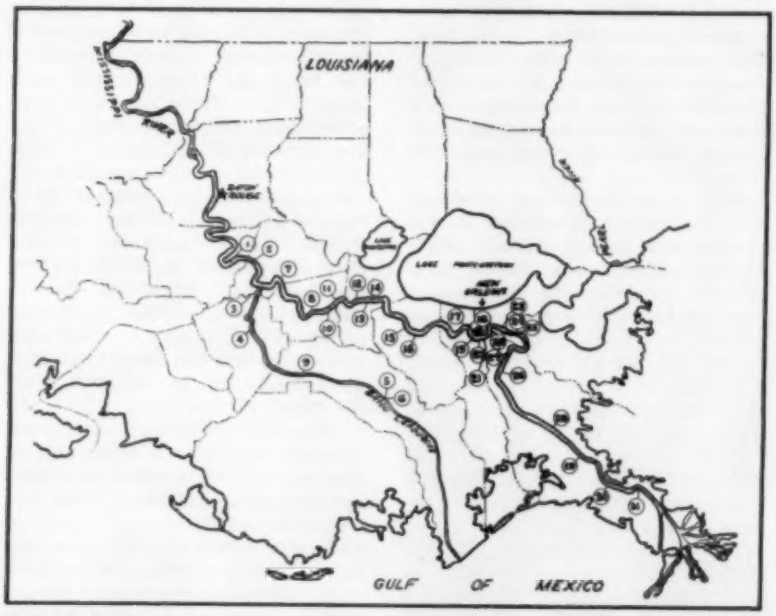
Some problems in the operation of the network have been encountered. One is that some plants lose their effectiveness as monitors after the first report is received on a pollutant in the water and the information has been transmitted. The water plant operators who have adequate storage capacity and have their storage facilities filled when the spill is reported, calculate the time the "slug" will reach them, based on the information contained in the warning to them, and discontinue producing water just prior to "P" or "Pollution" time. Each such plant discontinuing operation is no longer a monitoring station and the exact location of the contaminant as it progresses downstream may be lost.

A second problem encountered stems directly from publicity given to water problems. It is not always possible to determine immediately whether a reported pollutant is of a nature or in sufficient concentration to affect adversely the users or whether it is only a local problem. Of the large numbers of calls received very few are really significant, yet experience has indicated that the risk is far too great to fail to inform all of the downstream users when we receive a report.

The water departments once warned of an impending deterioration in water quality feel an obligation to warn their consumers and do so. This is fine, except in the great majority of cases where the discharges really pose no problem and the warning becomes a false alarm. However, waterworks officials and operators feel that no matter how many false alarms there may be, it is preferable to receive a false alarm than be caught without warning.

A real concern is the possibility that indifference on the part of the waterworks people may result because of numerous alarms which turn out to be false. We do not know what we can do about this since the period of warning is relatively short; and we do not have the time to determine whether the situation is a local one or whether it will affect all downstream users. The only choice we have is to report them and then give the all clear when we can.

It is interesting to note that there have been numerous reports of tastes and odors since the plan was put in effect and that in each case the transmission of information worked smoothly. Only one of these reports seemed to be general in nature, that is affecting a number of water plants, but the warning was timely enough so that changes in treatment could be made and the quality of water to the consumer was not badly affected.



● **LOCATION of water plant intakes along the lower portion of the Mississippi.**

LEGEND: 1 USPHS Hospital; 2. Wyandotte Chemical Co.; 3. Peoples Water Service Co.; 4. Assumption Parish W. W. Dist. #1; 5. Lafourche Parish W. W. Dist. #1; 6. Lockport Water Treatment Plant; 7. Ormet Corp.; 8. St. James W. W. Dist. #1; 9. City of Thibodaux Water Plant; 10. St. James W. W. Dist. #2; Colonial Sugars Co.; 12. St. John W. W. Dist. #3; 13. St. John W. W. Dist. #2; 14. National Sugar Co.; 15. St. Charles Parish W. W. Dist. #1; 16. St. Charles Parish W. W. Dist. #2; 17. Jefferson Parish W. W. Dist. #1; 18. Carrollton Plant, New Orleans; 19. City of Westwego Water Dist.; 20. Jefferson Parish W. W. Dist. #2; 21. City of Gretna Water Dist.; 22. Algiers Plant, New Orleans; 23. American Sugar Refining Co.; 24. Kaiser Aluminum & Chemical Corp.; 25. St. Bernard W. W. Dist. #1; 26. Dalcour W. W. Dist.; 27. Belle Chasse W. W. Dist.; 28. Pointe-a-la-Hache Water Works; 29. Freeport Sulphur Co.; 30. Buras W. W. Dist.; 31. Boothville Venice Water Works.

Runoff Storage Reservoir will Relieve Dry Summers

CITIZENS of the northwestern Missouri community of Bethany (pop. 3,000) are taking steps to assure that their city will never again experience a water shortage. The city's 200 acre-foot capacity reservoir on Big Creek dried up in 1953 and 1954 and was extremely low in 1958 as a result of prolonged droughts in the area. As a consequence, use of water for other than drinking and essential sanitary purposes was severely curtailed during the summer months.

A new reservoir started in 1960 will increase water storage capacity eight-fold, and spring runoff which cannot be handled by the present reservoir will be transferred to the new structure to be stored until needed.

The new dam will create a 76-acre lake, providing a capacity of 1,425 acre-feet. A major portion of the water to be impounded will come from the 1,000-acre watershed draining into the usually dry West Fork of Big Creek, but excess water from the old reservoir will be pumped through a 9,210-ft. pipeline, from a pumping station under construction at the original dam site.

The construction crew of A. E. Quinn (Salisbury, Mo.) moved onto the site April 19. Inclement weather has halted earthmoving much of the time, including heavy rains which filled excavations during May and June. Despite this fact and that only about 65 percent of the time allowed for completion had elapsed about 90 percent of the earthmoving on the $164,000 project has been completed by late fall.

The 60-foot high, 224,000 cu. yd. dam is 1,100 ft. long. It is 16 ft. wide at the crest and 400 ft. at the base. The upstream face slope is 2½:1; downstream face, 3:1. Berms will be placed 30 ft. from the crest on both faces, the upstream berm will be 20 ft. wide and the downstream one 30 ft. wide.

Prior to actual start of construction, the entire foundation area was cleared of all sand, muck and debris in the existing creek channel with Quinn's two Cat 619-442 tractor-scrapers and D8H power shift push tractor.

The core trench, cut to a maximum base width of 20 ft., was dug to impervious material in all areas. This required an excavation four feet deeper than was called for in the specifications to remove the weathered shale encountered beneath the valley floor.

Runoff from heavy rains in May partially filled the excavation several times. Removal of this unwanted water was accomplished by teaming the D8 and D7 tractors with blades full of imperious clay and slowly pushing the silt-laden water from the cut.

Excavation of the trench into the hillsides on either end of the dam required cutting 25 to 30 ft. into the slopes to reach solid, unweathered limestone. In each instance, five or six formations of limestone and shale with heavily weathered seams were encountered.

Fill for the structure was obtained from two borrow areas with the tractor-scrapers pushloaded by the D8H and placed selectively, random pervious material on the downstream portion and impervious upstream.

The entire upstream face of the dam, to a point within 10 feet of the crest, is constructed of impervious material. The downstream side of this impervious core, beginning at a point eight feet from the dam's center, is sloped at 1:1, random pervious material making up the remainder of the structure. Lifts are six inches in depth, compaction being to 95 percent standard Proctor with a D7 and 4 x 4 sheepsfoot roller.

To assure maximum stability of the slope, the structure was designed with a 50 foot wide by five foot deep drainage blanket of quarry run rock at the edge of the random fill. Water gathered by this blanket is picked up by 18-inch perforated corrugated metal pipe and channeled to the downstream channel with 12-inch pipe.

Placement of riprap on the upstream face of the dam above the berm was done in four stages to obtain a well-integrated mixture of the quarry run material at all levels. Following completion of each seven feet of fill, a six-inch layer of crushed rock is spread on the slope with a No. 12 motor grader. This material serves as a cushion for the quarry-run rock and tends to prevent drifting of the heavier pieces to the bottom, thus assuring more even distribution of all sizes along the slope.

Drawdown from the permanent pool of the dam will be controlled from a 63-ft. tower with intakes at three levels: 20, 36 and 50 ft. from the base.

The 50-ft. circular emergency spillway cuts around a low hill at the west end of the dam at a point approximately 500 feet from the center. Erosion protection is provided by a concrete sill and riprapping in critical areas along its length.

The designing engineer is Larkin and Associates of Kansas City, Mo. Concrete work on the structure has been subcontracted by A. E. Quinn to Sutton Construction Co. of Bethany, pipeline work to Jefferies Construction Co. of Osage Beach, Mo. Excavation of rock for the pipeline connecting the two dams was contracted by Donaldson Engineering and Construction Co., of Maryville, Mo., at $52,493. The six-man Quinn crew works six 10-hour shifts per week.

WATER SUPPLY TASTES and ODORS
Controlled by Potassium Permanganate

J. L. SMITH
Water and Sewer Superintendent
Waxahachie, Texas

TASTE AND odor problems in water supplies can ordinarily be handled by plant personnel if 1) the raw water supply is from a satisfactory source, 2) the plant is built to provide needed flexibility of operation and 3) the equipment has the capacity needed to feed ample treatment chemicals to proper points in the plant. The lack of these three qualities in our system, plagued our operation for taste and odor control during the summer of 1960.

Prior to 1957, the City of Waxahachie, Texas, got its entire water supply from deep wells. As the water demand increased an additional source of supply was badly needed. A survey was made to check the possibility of drilling another well, but this was reported impracticable. Consequently steps were taken to obtain a surface source and a treatment plant. Several sites for impounding water were considered and a location about four miles southeast of the City on the South Prong of Waxahachie Creek was selected. After all engineering and legal procedures had been handled, a contract was let and work started on the project. An earth-filled dam, 4,740-ft. long, was constructed, and a raw water pump station was built just below the dam. A 20-in. concrete pressure pipeline was laid 15,690 feet to the treatment plant site and a plant was built. Heavy rains (over 25 inches in two months) filled the lake to the spillway level before any of the vegetation was removed from the site. All brush, shrubs, and trees were submerged. Allen (2) explains how this condition affects a raw water supply. Hunter (3) also describes what to expect when vegetation is not removed from the reservoirs.

The treatment plant consists of a flash mixing basin, Clariflocculator, filters and a clear well, with an operating building housing the laboratory, chemical storage, feeders and an office. Lime, alum, carbon and chlorine are all added at the flash mix. Post-chlorination is applied to the filter effluent. Since there is no separate settling basin all chemicals are added at the same point and split treatment is impossible. The prechlorinator has a maximum capacity of 100 lbs. per day. Carbon, added in large quantities at the flash mixer, carries over to the filter and shortens the filter runs. However, the plant was able to take care of the minor taste and odor problems in the fall of 1957 and 1958, both of short durations. About July 1, 1959, we commenced experiencing tastes and odors of intensities more than the plant could handle by conventional operation. Threshold odor was above 20 and was intensified by our limited feed rate of chlorine, which also worked against the carbon. We moved the carbon feed to the lake pump station, hired extra personnel to keep the carbon equipment and pump in operation and pumped the carbon slurry to the discharge line going to the filter plant. The line retention period of about five hours was doing a fine job with the carbon, but prechlorination was stopped and post chlorination with ammonia was increased. This arrangement worked very well for the duration of the taste and odor problem which lasted for six weeks. No more taste and odor problems developed until about July 1, 1960.

For the first two weeks the previous year's treatment handled the problem very well, but by mid-July the taste and odor changed to a definite woody, earthy nature, increased to a threshold of about 40, and the treatment as being applied could not handle it. Silvey (4) reports that the particular taste and odor characteristic we were faced with is very difficult to handle.

The pump we were using to feed the carbon slurry was limited in capacity, and when we tried to increase the concentration of carbon, the pump could not handle the heavier slurry.

For some time we had been considering the possibility of using potassium permanganate for taste and odor treatment. Jar tests in our laboratory showed good results, but we could find no information on its application. However, we phoned an order to our chemical supplier, and through the supplier we made contact with Charles Lewis, Applications Engineer with the Carus Chemical Company. He spent several hours in our laboratory and when we had assembled our shop-made solution feeder we were ready to start feeding potassium permanganate solution following the tests and instructions given by Mr. Lewis. Later, S. Bruce Humphrey, Director of Marketing of the same firm, spent two days advising and

● **AFTER jar tests showed that taste and odor control was possible with potassium permanganate, this simple equipment was used to feed the chemical to the raw water.**

● **HEAVY RAINS filled the new reservoir before vegetation could be removed from the basin. This resulted in the creation of very serious taste and odor problems.**

instructing as to proper procedures.

We discontinued feeding carbon at the pump station and started the potassium permanganate treatment at the rate of 0.375 mg/L. Carbon feed was resumed at the treatment plant but reduced from the 50 mg/L treatment at the pump station to 5 mg/L at the treatment plant, applied to the top of the filter. This reduced the threshold odor to< 2. After about 10 days the potassium permanganate dosage was increased to 0.5 mg/L. This treatment was sufficient to control taste and odor until August 5, 1960, when we increased the dosage, this time to 0.75 mg/L. This amount proved to be sufficient to handle the taste and odor problem until rains in mid-December flushed the lake and corrected the condition.

We made tests on the filter effluent and tap water during the potassium permanganate treatment but failed to find any manganese in the water. The insoluble manganese dioxide was removed in the clarifier with coagulation, and the filter sand showed no manganese deposit. By using potassium permanganate our taste and odor treatment costs were only about 10 percent of the expense for the taste and odor treatment the previous year, not including the extra personnel previously needed at the pump station.

Tests for potassium permanganate demand for taste and odor control are very simple. Approximate permanganate demand is readily determined by simple titration. The purple color serves as an indicator and if there is any residual permanganate color after a period comparable to plant residence time, the dosage should be reduced. Jar tests with a typical multiple stirrer worked fine. Our procedure was as follows: Fill six quart jars with water to be treated and add a measured amount of permanganate test solution of known concentration to each jar, making up final concentrations of 0.25, 0.375, 0.5, 0.625, 0.75 and 1.0 mg/L. In our laboratory all color of potassium permanganate in the sample treated to 0.750 mg/L, was gone after 48 minutes of stirring. A slow mix of about 30 rpm, simulating plant conditions, seems to provide the best results. The treatment of 1.0 mg/L still held color after two hours. Tests proved the color would be removed by coagulation, but we felt the 0.75 mg/L treatment was sufficient and any in excess of that amount was unnecessary.

We are convinced that potassium permanganate has great possibilities as a taste and odor treatment, worthy of a lot of research in any operator's laboratory, and for serious problems, it is very economical. Potassium permanganate does not combine with the substances causing taste and odor. It works as an oxidizing agent so there seems to be no possibility of intensifying or "setting" taste and odor. The residual manganese dioxide is insoluble, is adsorbent, assists the coagulation process and is removed by coagulation and filtration.

References

1. Middleton, Francis M., Rosen, Aaron A., and Burtchell, Rice H., "Taste and Odor Research Tools for Water Utilities," *Journal AWWA*, January, 1958.
2. Allen, E. Jerry, "Taste and Odor Problems in New Reservoirs in Woody Areas," *Journal AWWA*, August, 1960.
3. Hunter, Homer A., Chapter III, Surface Water Supplies, *Manual for Water Works Operators*, Texas Water and Sewage Works Association.
4. Silvey, J.K.G., Chapter XI, Algae and Associated Organisms, *Manual for Water Works Operators*, Texas Water and Sewage Works Association.

LOADER SPEEDS SEWER CLEANING WORK

THE HOPPER attachment on the O'Brien bucket loader shown above dumps directly into a truck, thus preventing the accumulation of debris on the street and avoiding a separate loading job. The new powerized machine, a product of O'Brien Mfg. Co., Chicago, utilizes a continuous rod to pull a steel bucket through the sewer and depositing the debris resulting from the cleaning directly in the hopper.

SEALING SEWERS

BY EXTERNAL GROUTING OF JOINTS

FRED D. DAHLMEYER
Engineering Inspector,
City of Hollywood, Florida

THE PROBLEM confronting the City of Hollywood, Florida, is how to cope with the high rate of infiltration into its sewer system. The elevation is only 7 feet above mean sea level with building concentrated along the ocean front. The sanitary sewer system, which serves primarily the coastal section of the city, is mostly below the ground water table. Hydrostatic pressure and infiltration increase with rainfall and with seasonal high tides.

The 60 miles of trunk lines and 22 miles of laterals service 5300 house connections. Along the beach section in some areas the lines are supported on rigid pilings because of the plasticity of the soil. Conventional bituminous poured joints were used in most cases.

The year-around population of the city is about 34,750, which increases to about 65,000 at the peak of the tourist season. Estimated water consumption from the area served by the sewer system is about 2.4 mgd, yet the flow received at the sewage treatment plant averages 8.1 mgd. The difference could not be accounted for by industrial connections because only a few light industrial plants are tied into the city system. Storm water drainage is handled by a separate system. All manholes are pressure sealed to prevent infiltration from the surface. Consequently ground water is the only possible source of infiltration amounting to 5.7 mgd.

There are six lift stations and a central treatment plant in the system. Allowing the situation to remain uncorrected meant continued high pumping costs and operation of the sewage treatment plant with no reserve hydraulic capacity. Nevertheless, possible corrective measures were few and costly. Certain lines could be bypassed to leave the worst sections inactive. The system or portions of it could be replaced. Joints in the 18-in. or larger pipe sections could be resealed from the inside with lead wool, cement or polyethylene sleeves. These methods would result in either undesirable service or be prohibitive costwise.

Still another and far more reasonable method was to seal permanently the leaks with cement applied from outside the pipe. This solution was selected after considering all alternatives on the basis of the relative costs, durability of repairs and the possibility of making repairs without interrupting normal operating routine. Accordingly the City enlisted the services of a firm which had developed and patented a method of cement grouting, Douse and Sons, Inc., of Fort Lauderdale, Fla.

Initially a survey of the condition of the inside of the pipes was required to determine the approximate location and severity of the leaks. By plugging up one end of a section, the amount of flow from the other end would indicate the areas of greatest infiltration. City forces cleaned out the lines and estimated the amount of infiltration to provide a priority list of portions of the system requiring attention.

In locating leaks the first step in the procedure is to float a lightweight line from one manhole to another. After this line reaches the end of the section, a stout line is pulled through the sewer. Next a fluorescent lamp is fastened to adjustable skids and is secured to the end of the line. A 2½-foot chain at the end of the skid pulls another skid holding a television camera.

The camera has been modified to fit into a stainless steel cylinder five inches in diameter and 2½ feet long. A coaxial cable to the rear of the camera carries the necessary power for the camera and the lamp. This cable is also used for moving the camera backward.

All electrical equipment is powered from a small portable gasoline-powered generator. The signal from the coaxial cable is received in a device known as the TV eye. This complements the monitor and provides the fine tuning necessary to obtain the best reception.

Inspections by TV

The operations during a typical day are described as follows:

The flow of water through the section is stopped by plugging off the lines at the upper ends with in-

● **TYPICAL moderate leak is shown as it appears on the TV screen. Photographs can be made of the screen to provide a permanent record of the conditions encountered.**

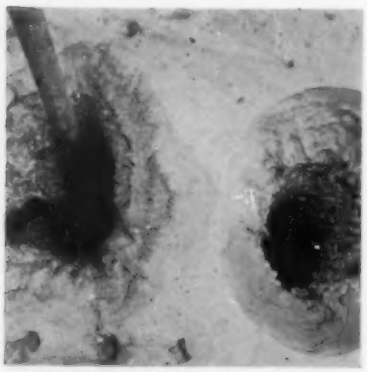
● **LOCATION of the leak is spotted by distance from the manhole and a pipe is jetted down hydraulically to the sewer.**

● **AFTER jetting has been completed, the same pipe is used to force special grout down into the space around the joint.**

flatable canvas bags, air lift bags or mechanical stoppers. The camera and light are lowered into the manhole and positioned in the invert. The camera is then drawn through the lines either manually or with a power winch if the circumstances warrant.

Infiltration, exfiltration, cracked and crushed pipe, dropped sections, tree root growth, grease deposits and leaking laterals can all be clearly viewed and permanently recorded on film.

An inspector assigned by the city records all unusual conditions in a field book and photographs them for his reports, using a Polaroid camera to take pictures of the TV monitor. Location is determined by a tape affixed to the fluorescent light, which is used to measure the distance from the center of the manhole to the defect. The photographs are immediately mounted on a report sheet, location is noted and the severity of leaks and other conditions is recorded. "Before" and "after" photos are required on all leak repairs.



● **TYPICAL voids resulting from the jetting operations. Sealing program resulted in marked decrease in infiltration.**

The second phase of the operation is undertaken by the contractor. A pipe is hydraulically jetted down to the point of infiltration. The pressure forces soil into the leak, thereby temporarily sealing it. A void is also created above and around the joint by compacting the naturally porous soil.

The monitor operator would normally notice an increase in the size of the leak as the jetting pipe approaches. When the pipe comes to within a few inches of the leak, all the weak material in the joint is blown into the inside of the pipe, creating an impact similar to an explosion. Immediately the fines in the ground rush in to plug up the gap. The operator then signals the jetting crew to stop the flow of water and fill up the void created with a special cement grout. The grout is pumped down the same pipe used in the water jetting until the void is filled and no more cement can be pumped. In effect the joint becomes diapered with a large band of cement.

The results of Hollywood's repair program have eliminated panic pumps from the lift stations, greatly reduced the infiltration and therefore reduced the workload at the disposal plant and provided a current evaluation of the condition of the sewerage system. In October, 1960, the plant was averaging 9.8 mgd. After the repair contract had been completed the average diminished to 7.1 mgd at the end of December and below 6 mgd in the early part of January. The water table had dropped some by January but it was felt that a lion's share of the credit for the decrease was due to the two-month repair program.

• • •

Water Taste and Odor Study

A program of study to develop information and analytical procedures for taste and odor in water is under way at the Franklin Institute in Philadelphia. Sponsored by the Manufacturing Chemists' Association, the study seeks to establish a sound technical basis for the control of chemical plant waste water discharges to avoid creation of taste and odor problems.

The following objectives have been announced:

1) Develop an acceptable, reproducible method for measuring odor.

2) Determine the effect of such primary variables as odor type and concentration and their effects on each other. The control of waste water discharge based on single chemical concentration limits is inadequate, but little is known of the effect of complex mixtures.

3) Determine the effects of human factors. Odor measurement is a subjective test and complaints, control and regulation are made by persons differing in stimuli response. The interaction of the human factors and the chemical factors is poorly understood and also requires clarification.

4) Develop a reproducible scale for measuring odor intensity.

5) Develop a reproducible and meaningful method of characterizing or describing odors.

PUMPING WATER BY AIR-LIFT

PUMPING water from wells by the air-lift method finds practical application in testing and developing wells. Also, under special conditions, an air-lift may be preferable to other types of pumps as permanent pumping equipment.

Practicability of the air-lift for testing and developing wells stems from these advantages: 1) Equipment is easily improvised and installed and 2) it is readily converted from a pump to an effective development tool; 3) it is not subject to damage when sand is pumped with the water; and 4) the power unit, directly coupled to compressor, does not have to be specially set up for driving the pump.

Depth to the static water level and total depth of water in the well impose limitations on the application of air-lift pumping. Even so, the method can be applied in a large percentage of cases.

An air-lift operates by the injection of compressed air directly into the water inside a discharge or eductor pipe at a point below the water level in the well. The operating principle is shown in Figure 1.

The piping assembly used for air-lift pumping from a well consists of a vertical discharge pipe—called the eductor pipe—and a smaller air line. Both pipes must be submerged in water in the well with 40 percent or more of their lengths extending below the pumping level.

The compressed air is forced down through the air pipe and released inside the eductor pipe. The mixture of air bubbles and water results in a fluid column inside the eductor pipe with lower specific gravity than the water outside the pipe. Because of this, water and the entrained air flow upward and out of the top of the eductor pipe. The energy that operates the air-lift is that which is contained in the compressed air.

The well casing itself can be used for the eductor pipe, if desired, providing the diameter of the casing is not too much larger than the air line. This provides a practical way to pump sand and mud from the bottom of a well during development and cleaning operations. When test-pumping a well, however, it is better to use a separate eductor pipe since the pumping level can then be measured.

The two most important factors in air-lift pumping are the percent submergence of the air line and the relative sizes of the air and eductor pipes. Generally, the air-lift works best with a submergence of 60 percent or more.

This article is reprinted in part from the November-December, 1960, *Johnson National Driller's Journal* and is copyrighted by Edward E. Johnson Inc.

Submergence is the proportion of the length of the air line that extends below the pumping level. It is the footage of air line submerged below the pumping level divided by the distance from the level of water discharge to the lower end of the air line and multiplied by 100 to give the result as percentage. In Figure 1, the submergence is A divided by B, expressed as percentage.

To be strictly accurate, the friction loss in the eductor pipe should be added to the overall length of the column of air-and-water mixture when calculating percent submergence, but usually this factor is neglected.

It is important to remember that percent submergence always refers to submergence of the air line while pumping and is calculated from the pumping level rather than the static level.

For example, assume in Figure 2 that the working submergence, A, of the air pipe is 80 ft. and the lift, L, is 120 ft. The distance from the point of discharge of the water is, then, 200 ft. The percent submergence is 80 divided by 200 multiplied by 100, or 40 percent.

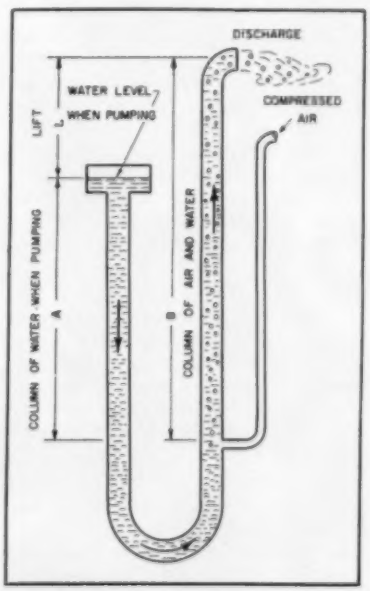
The length of air pipe below the static water level is of significance only for determining the air pressure required to start the air-lift. The number of feet of water from the static water level to the lower end of the air pipe divided by 2.31 gives the required air pressure in pounds per sq. in.

A foot piece that breaks the air into small streams so that the bubbles formed will be as small as possible improves the efficiency of the air-lift. This can be improvised by drilling a number of small holes in a short section of pipe which is then attached to the lower end of the air line.

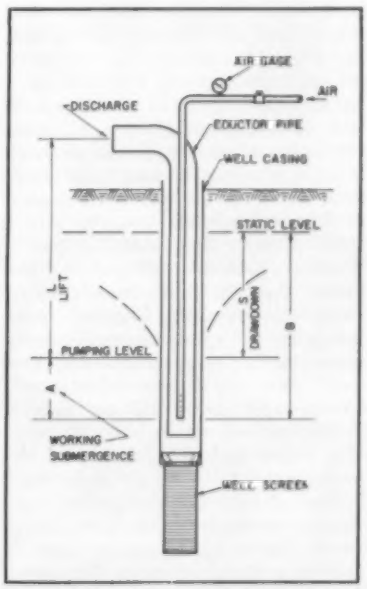
Submergence Is the Key

The performance of an air-lift varies greatly with the submergence and height of lift. Although submergence of about 60 percent is desirable, in wells where the pumping water level is rather deep the operation must be carried on with lesser submergence.

Table 1 gives performance data for well-designed air-lift pumps



● **FIGURE 1. Diagram shows the basic principle of operation used in pumping by the air-lift method.**



● **FIGURE 2. An air-lift pump. Submergence is A divided by A + L, and is expressed as a percentage.**

Table 1—Comparisons of Air-Lift Performance

Lift, ft.	Submergence Below Pumping Level ft.	%	Gal. Water per cu. ft. of Air	Length of Air Line, ft.	Rating
25	29	54	4.55	54	Minimum
	53	68	8.34	78	Optimum
50	52	51	2.50	102	Minimum
	93	65	4.35	143	Optimum
100	89	47	1.43	189	Minimum
	150	60	2.70	250	Optimum
150	113	43	1.05	263	Minimum
	183	55	2.04	333	Optimum
200	139	41	0.85	339	Minimum
	216	52	1.54	416	Optimum
300	176	37	0.60	476	Minimum
	115	47	0.96	566	Optimum

Table 2—Pipe Sizes for Air-Lifts

Pumping Rate, gpm	Min. Size of Well Casing	Size of Eductor Pipe, in.	Size of Air Line, in.
30 to 60	4" or larger	2	½
60 to 80	5" or larger	3	1
80 to 100	6" or larger	3½	1
100 to 150	6" or larger	4	1¼
150 to 250	8" or larger	5	1½
250 to 400	8" or larger	6	2
400 to 700	10" or larger	8	2½

corresponding to various conditions of submergence and for a series of lifts. The figures relate to properly proportioned air and eductor pipes with minimum friction losses. The efficiencies indicated in terms of gallons of water per cu. ft. of air probably cannot be attained with improvised air-lifts for test pumping and developing wells.

Less submergence than indicated in this table can be employed in well development since continuous discharge of water is not desired. Alternate pumping and back pressure produce the desired reversal of flow through the openings of the well screen. The short pumping phase of the cycle will not pull the water level to the same depth as continuous pumping. Thus, the submergence for a brief period is sufficient to discharge water and fine sand from the bottom of the well in intermittent "blows" or "heads."

Slippage of air bubbles through the water and the friction of the water in the discharge pipe cause losses of effective energy and reduction in efficiency. As the velocity of the discharge increases, there is less loss from slippage but more loss from friction. Data developed by Ingersoll Rand Co. indicate that the best discharge velocity of the air-water mixture for lifts from 40 to 200 ft. varies from 2,000 ft. per min. at 35 percent submergence to 700 ft. per min. at 70 percent submergence.

Velocity Factors

The velocity in the eductor pipe depends upon the volume of air and water being discharged and the cross-sectional area of the annular space between the air line and the eductor. Table 2 gives the sizes air lines for various sizes of eductors that should be used under most conditions. When the water yield is unusually low, the difference between the sizes of eductor and air pipes may have to be less in order to reduce the area of the annular space and thus increase the discharge velocity enough to prevent excessive air slippage in the eductor. This condition often dictates using a larger-than-normal air line when pumping directly from the well casing without a separate eductor pipe.

Best operation also requires good regulation of the amount of air injected. Too much air causes excessive friction in the pipe lines and waste of air. Too little air results in a reduced yield and in a surging, intermittent discharge.

When test pumping a well without using a separate eductor pipe, the drawdown can be roughly estimated by noting the maximum gage pressure on the air line in starting the air-lift and the operating pressure when the discharge becomes steady. The difference between the two readings (in psi) multiplied by 2.31 gives a rough measure in feet of water for the difference between the static level and the pumping level.

Suppose, for example, the maximum air pressure shown by the gage upon starting the air-lift is 70 psi and that when pumping at 100 gpm the gage shows a working pressure of 50 psi. The pressure difference is 20 psi multiplied by 2.31 gives 46 ft. as a rough estimate of the drawdown at a pumping rate of 100 gpm.

Start at Low Rate

When developing or cleaning a well with an air-lift, the discharge should be started at a very low rate and brought up gradually. The air flow should be slowly increased in proportion to what appears to be the increase in water flow into the well from the water-bearing formation.

Highly efficient vertical-shaft turbine pumps and submersible-motor turbine pumps have displaced the less efficient air-lift in most permanent-type installations. However, the air-lift will continue to be an extremely important tool for test pumping, developing and maintenance cleaning of water wells of all sizes.

• • •

Survey Indicates Nationwide Needs for Sewage Treatment

The Conference of State Sanitary Engineers completed a comprehensive state-by-state survey of unmet treatment needs on January 1, 1961. This disclosed a current backlog of nearly 5,300 needed new plants, plant enlargements, and plant additions. These projects, together with related interceptor and outfall sewers, are required now to treat the raw and inadequately treated wastes presently being discharged to the nation's waters from a population of almost 46 million. The estimated total cost of the facilities is $2 billion. Of the cost of remedial work, 48 percent is in communities of less than 10 000 population, 24 percent in cities from 10,000 to 50,000 and 28 percent in larger cities.

This is a quotation from an address by D. H Howells of the Public Health Service at the Associated General Contractors meeting in Boston.

ULTRASONIC CLEANERS CUT OUR PARKING METER MAINTENANCE OVERTIME

● THE AUTHOR, left, and Meter Foreman L. J. Indiere, inspecting the working parts of an ultrasonically cleaned meter to check on grease and street dirt removal.

● UP TO four parking meters can be cleaned at one time in less than five minutes.

GEORGE H. SMITH
Superintendent of Public Works
Huntington, Long Island

A SEEMINGLY endless job has been considerably expedited for our department by use of ultrasonic cleaning methods coupled with efficient checking and servicing operations. The 1200 Rockwell Dual and Mark Time parking meters in the Town of Huntington require constant checking, cleaning, and repair, for they see unusually heavy duty. Our staff of three inspectors is able to maintain close scrutiny through carefully planned checking tours, but the problem of cleaning the dozens of meters which are brought in each day for cleaning and overhauling is a difficult one.

Until last spring, we used a spin cleaning apparatus to effect the initial cleaning of the assembled meters after removal from the outer case. Although this method gave generally good results, the time factor involved (about 30 minutes for each meter) constituted a considerable drawback for our parking meter foreman, Louis J. Indiere, who is in charge of all cleaning operations.

In addition to the valuable time consumed by the spinning treatment, it was necessary to dry the cleaned meters by means of a second spinning process, which brought the total working time for each meter to more than one hour. To complicate the situation further, we were only able to clean one meter at a time, since the spin bath would have damaged delicate parts by repeated hard contact.

Early last year, we investigated the possibilities of the new ultrasonic cleaning process. We had been told of the thoroughly efficient cleaning job these cleaners are capable of by virtue of their unique cavitation or "cold boiling" action, which blasts off contaminants quickly and completely. We learned, however, that it would be necessary to tune the wave production of the cleaner to each change in cleaning conditions, such as temperature of the solution, number of meters

being cleaned, level of the liquid in the tank, and the like. This tuning, a prerequisite to maintaining proper cleaning efficiency, would require constant surveillance by an operator trained in the electronic principles involved, and would have cut deeply into the time savings we would be able to realize by use of the method.

We were ready to write off the idea, until we heard of a new type of ultrasonic cleaner which had been developed by Powertron Ultrasonics Corporation, located a few miles from us at Garden City, N. Y. Their development, called the Autosonic cleaner, tunes itself to the changes mentioned above, maintaining peak cleaning efficiency without the need for continual attention and adjustment. In fact, we found that the only control our operators would have to familiarize themselves with was a single on-off switch.

The Autosonic cleaner, which we put in use on a trial basis last June, accomplishes this self-tuning by means of a feedback principle in its special transducer (the element which produces the ultrasonic waves which in turn cause the cavitation in the cleaning solution). The transducer senses the changes in conditions and makes the necessary adjustment in power output and wave length. Thus, we are able to clean varying numbers of meters at a given time, under varying temperature conditions, merely by switching the apparatus on and letting it tune itself.

The ultrasonic method removes all street dust, grease, and other contaminants completely and quickly. Up to four meters can be cleaned at one time with an ordinary industrial detergent in less than five minutes, cutting the former cleaning time by one-sixth. After a simple hot water rinse, the units are ready for drying, inspection, and reassembly. The latter involves little more than replacing the meter mechanism in the case, since the cleaning penetrates to the inner parts of the assembly without the need for stripping down the mechanism.

Our use of the new method provides extra time for Mr. Indiere to take care of parts replacements and repair, and has resulted in a marked increase in efficiency in the servicing of Huntington's parking meters. The cleaning unit, a 100 watt model with a 2 gallon capacity tank, is a compact combination of generator and tank, which requires only a fraction of the space consumed by our former cleaning apparatus.

SEWER MAINTENANCE CREW SPECIALIZES IN SAFETY

A. J. MAIR

NO MATTER how good your safety equipment is, it is no good back at the shop when the men on the job should have it with them. Getting safety equipment has never really been a problem. Getting it used properly has been.

The Sewer Maintenance Section of the City of Edmonton (Alberta) Engineering Department has taken a big step forward in promoting the use of safety equipment. It is an idea that can be used anywhere.

For purposes of sewer maintenance, Edmonton is divided up into areas or "beats" having approximately the same length of sewers. Responsible for each beat is a crew of maintenance workers operating from a truck upon which they carry their basic tools. Part of the crew's responsibility is to patrol the trunk sewers on their beat each winter during the extremely cold winter months. In this way they are able to determine, by actual visual inspection the condition of any line big enough to put men through. There is nothing unique in all this.

There is nothing unique, either, in the continual problem that plagued the supervisors when they tried to teach, encourage and even enforce the use of the safety equipment that must be used on such a hazardous job. Staff turn-over, indifference, casualness that comes with over-familiarity with the work on hand, and a hard core of old timers who would hitch up their pants and crawl into an 18-inch line were all problems that were continually dealt with.

The Idea

Then came the idea: Start with a gang of keen men, eager to do a good job, and teach them everything possible about safety as it applies to trunk sewer patrol. Get them good equipment and let them patrol all the trunk sewers in the City. Get one crew using good technique on a hazardous job, and the idea catches on and spreads.

This was the basic idea; it was tried; and it works.

Another vehicle was to be added to the fleet of sewer maintenance trucks anyway, so a ¾-ton panel was purchased and with surprisingly few modifications was fitted up for the specific purpose of trunk sewer patrol. With the addition of just a few more features, it also became an emergency vehicle for the whole sewer construction and maintenance division.

A two-way radio was installed, tuned to the Engineering Department's frequency and the truck was in touch with the central switchboard at all times.

Equipping the Truck

The first things that went into the truck were pretty basic. Wooden tool boxes were built with tilt-up lids and installed down either side of the interior of the panel. The lids were padded, and these boxes became benches for extra passengers; ordinary hand tools were stored under the lids. Picks, shovels, knee pads, spare gloves, short ropes and buckets and the assortment of small hand tools that the crew carry may be found here.

Immediately behind the front seat and for the full width of the panel itself a wooden cupboard was built dividing the front half of the truck from the back. The doors to this cupboard were built to swing into the rear of the panel. On one side are kept hard hats, safety lights and clean gloves; on the other side of the cupboard, smaller, carefully built compartments hold specialized equipment. Gas detectors, with chemical filled glass tubes to help in the detection of any gas the men might encounter are kept here. The first aid supplies are stored in this section as well, and the stock is always kept up. On a shelf at the bottom of the cupboard is kept a portable hand-held amplifier that can get a spoken message down a manhole and up a line if necessary. All of these things are in the cupboard behind carefully fitted wooden doors.

On hooks mounted to the inside walls of the panel the crew hang their gas masks. The masks are the compressed air type, the same as are used by the City Fire Department. That means they can be checked and recharged at the Fire

● **SAFETY IN SEWER MAINTENANCE:** *Above, left, shows use of parachute harness adapted to take a rope sling for lifting men in and out of manholes. Right is a rear view of the truck with rope and stretchers on top and other equipment inside.*

● **SAFETY EQUIPMENT** *inside the truck includes the many items listed on the opposite page, plus fire extinguishers, drinking water, a wash basin and first aid materials. At right above crew member is adjusting one of the city's standard gas masks.*

Department depot whenever needed. The smudges on the canvas carrying cases holding the masks mean just one thing. They are being used in the sewers, not merely hung up on the shop wall.

The truck carries some things you cannot buy at the safety supply store, too. You can reach into one of the tool boxes and find sets of webbing that look familiar. They are familiar when you hold them up. They are parachute harnesses, adapted to take a rope sling for hoisting men into and out of manholes and shafts. The harness can be slipped on quickly and over the heaviest of working clothes and provides a safe comfortable means of support.

Mounted on racks on the top of the truck are two stretchers, one basket type, the other a folding canvas one. Mounted with the stretchers are the long lengths of rope that could be vital in time of emergency.

Even the space behind the front seat has been put to use. Two fire extinguishers, drinking water, and a small metal wash basin are kept here. Ever tried to bandage something with dirty hands?

The men to use the truck were selected as carefully as the equipment they use. The Fire Department took them over when they had been chosen and trained them in first aid, smoke and gas procedure, how to wear a mask and all kinds of little tricks that they had learned by experience. The Civil Defense people took over next, and gave them more instruction on things like poison gases and what to do with them, how to transport the injured, and the rigging and use of rope slings and hoists.

All this gave the City the men and the tools to do a difficult job. But this is more than just a specialized crew that can do only one thing. They are not kept busy on trunk sewer patrol all year by any means; with their truck, their equipment and their training they fit right into the normal sewer maintenance staff. With just a little extra organizing by management, the crew is kept profitably busy all year and yet is always available for emergency use or tricky jobs if needed.

These men and their truck may represent a little more than just an ounce of prevention, but they have never needed a pound of cure.

TUNNEL GETS AUTOMATIC

WILLIAM F. HALLSTEAD

TWO YEARS of on-the-scene study by the Toll Facilities Division, Maryland State Roads Commission, and the J. E. Greiner Company, consulting engineers, have made possible a highly effective new signal system for the Baltimore Harbor Tunnel. Where 45 minutes were formerly needed to close one of the twin tubes manually and to divert traffic into the other, the job is now accomplished in a routine 7 minutes or less. Where the old system required some 50 extra manhours per week, the new automatic installation requires none.

Though it lacks the nationwide fame of the Holland and Lincoln Tunnels, the Baltimore Harbor Tunnel is the longest twin tube trench type vehicular tunnel in the world. Its 17 miles of approaches comprise one of the nation's most extensive denied-access urban expressways. On peak days, 55,000 vehicles rush along the high speed approaches, and pass through the 14-lane toll plaza and the tunnel itself to bypass Baltimore City. The likelihood of an emergency is ever-present and effective routine maintenance is a must. A highly efficient signal system is an indispensable factor in the operation of this complex, heavily-traveled facility.

The new sign and signal system begins one mile north of the Canton or north end of the tunnel, and ends at the toll plaza which lies ¾ of a mile south of the tunnel's south portal in Fairfield. All of the electrical signs are of the overhead type and are mounted on "Monotube" sign spans. The signs and mountings were manufactured by the Triangle Sign Company, Baltimore. Blumenthal-Kahn Electric Company of Baltimore was the contractor for the installation.

The signal system is activated by a two-step switch located in each of the emergency garages adjacent to the cross-over points of the tunnel ramps. The first step directs all approach traffic into a single lane: either the passing (fast) lane if it is to cross the median, or the right hand (slow) lane if it is not. The second step directs traffic to cross the median and use the other tube. Operational control is vested in the shift commander of the patrol force, or if he is otherwise engaged and unavailable, in the desk sergeant at the control desk located in the Fairfield Service Building near the toll plaza.

Minimum manpower required for actual operation of the new system is two men who are already on duty; one officer at each median break adjacent to the emergency garages. At these points, traffic is shunted through the median to two-way operation in the open tube. The officer is required to set up a few temporary cones and to remain on station to eliminate possible last-minute confusion at the actual point of lane transfer.

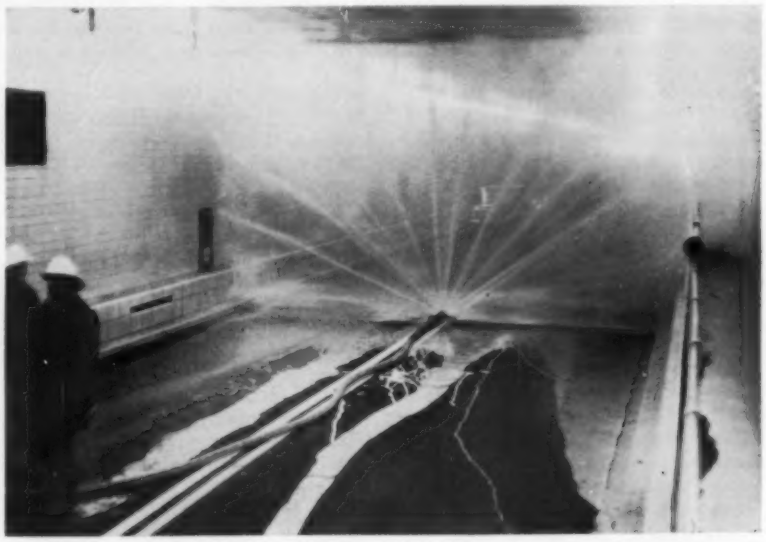
The first warning the driver encounters upon entering the signaled zone is a prominent overhead neon sign reading *SLOW — SINGLE LANE AHEAD*. The word, *SLOW*, is flashing. The second sign, also a neon overhead type, reads, *MOVE LEFT* (or *RIGHT*). Below this legend are three neon arrows, animated to indicate a left or right movement. The third and final overhead neon sign is actually two signs, one over each lane, reading, *THIS LANE ONLY*. The proper sign is activated by the master switch selection.

Next encountered are standard overhead traffic signals, one over each lane. Suspended between the signal heads is a prominent painted sign: *OBEY LANE SIGNALS*. The final overhead set-up is another set of traffic signals, this one just preceding the median break and the temporary cone arrangement.

Traffic approaches the north portal at some 55 mph, and the signal system signs here are set approximately 800 ft. apart. At the south approach, where traffic meets the first warning sign after a stop at the toll plaza, the signs are spaced at about 400 ft. because of the lower operating speed.

Upon orders from the shift commander, the applicable switch (or switches) is thrown activating the system for either left lane or right lane confinement at one or both approaches to the tunnel, depending upon the situation. Progressive delay of the traffic signals and of the lane control lights within the tubes permits vehicles within the system to proceed without passing a red indication.

The system's effect upon drivers is more rapid at night, due, no doubt, to the attention-commanding characteristics of the brightly lighted animated signs. In the daytime, the neon signing loses much of its ability to command attention because of the lower relative brilliance and because the driver is subjected to the usual scenic diversions. This writer watched the activation of the signal system during daylight hours —a routine activation for purposes of a fire drill during which the northbound tube was closed. Several drivers continued beneath the big neon *MOVE LEFT* sign (the right lane was closed in this drill) in the right lane, some simply following the negligent driver preceding them.



● **NO SHOWER bath, but a test, in the tunnel, of a fan-like fog nozzle for its effectiveness in confining smoke and fumes. Exhaust fans can clear tunnel quickly.**

SIGNAL SYSTEM

Most drivers were heeding the *MOVE LEFT* sign, however, immediately upon entering the system. An excuse for the unobservant drivers might lie in the fact that in the area observed, they were just pulling out of the toll plaza and expecting to return to the business of open road driving, only to be confronted with a sign confining them to one lane. A few operators persisted in using the closed lane past the *THIS LANE ONLY* sign. They encountered a red light 400 ft. further on which proved to be a highly effective barrier. Drivers are so well attuned to red and green lights that reaction is almost (but not quite) automatic.

As to the fairly high rate of unobservance of the neon group in the daytime, it was the opinion of one attending engineer that perhaps drivers are becoming "sign saturated"—that the welter of directional, instructional and warning signs along many of our expressways has developed an attitude of subconscious disregard on the driver's part. It would seem in an increasing number of instances that a sign—like a magazine cover—must really "have something" to catch the surfeited eye. This, of course, could ultimately be self-defeating. A suggestion worth consideration is that traffic engineers very carefully review the actual need for and value of proposed and existing signs and ruthlessly eliminate those that do not strongly justify themselves.

One highly oblivious driver during the fire drill operation heeded no signs whatever, ran both red lights, passed a long line of vehicles awaiting the moment of lane transfer through the median, and screeched to a startled halt only when he (a male driver; not female) spotted the officer at the cross-over point. Such vehicle operators are proof that no signal system can possibly be 100% effective—foolproof is a better word.

As traffic which has been transposed leaves the tunnel, it approaches a set of signals and signs directing it to recross the median to the normal travel lanes. After the traffic has passed the cross-over point, it is advised to *RESUME TWO LANE TRAFFIC* and continue the express trip.

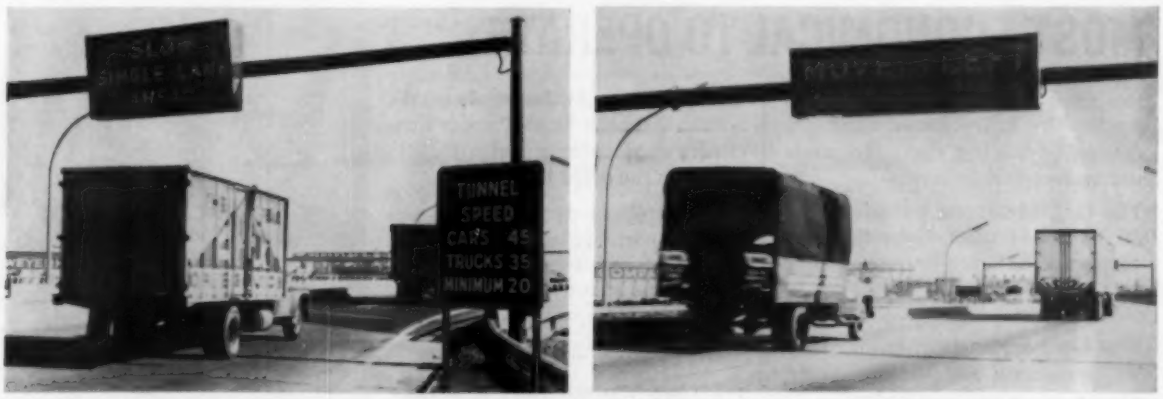
The new $100,000 signal system is justified on the basis of safety alone. With it, normal two-lane traffic in each tube can be channeled into single lane operation leaving the adjacent lane closed, or one tube can be completely closed—all in under 7 minutes. For routine maintenance activities, the system finds constant use. With its assistance, both tubes are washed each week and periodical inspections and repairs are made.

The washing procedure requires closing of each tube on alternate nights. The actual operation is accomplished by tank trucks mounting a circular ring of spray nozzles. In the first days of the tunnel's operation, these trucks carried 150 psi pressure, but present technique calls for a pressure of 600 psi. The detergent mix is a "home brew" evolved by the tunnel maintenance crew after much experimentation. A truck makes the washing run at 8 to 10 mph. This is followed by a double rinse, and the ensuing 3-hour drying period is utilized by repair crews to replace burned out fluorescent tubes, check the in-tunnel signaling system and perform other routine maintenance.

With the new signal system ready to go into operation at the flick of a switch, even a major conflagration within the tunnel should not become more than a highly localized problem. Traffic would immediately be prevented from entering the tube involved. Those beyond the fire area would continue out of the tunnel in a normal manner. Only the vehicles entering the tunnel behind the vehicle involved and before the system was activated would be inconvenienced. It is safe to assume that practically all of these vehicles could back out since there would be no traffic jam behind them, all ensuing traffic having already been diverted into 2-way operation in the other tube.

Even drivers and passengers remaining in the tunnel apparently have little to fear from smoke or fumes. This writer witnessed a fire drill using a trough of burning oil and rags which was intended to fill the mid-portion of the northbound tube with dense smoke. The smoke insisted on traveling along the ceiling toward the tunnel portals in a fairly rapid stream—even with the tunnel fans turned off. There was ample breathing space below the smoke level except when the smoke was purposely confined between two wall-to-wall water barriers created by special spray nozzles. Even then, the smoke was completely exhausted within two minutes after the high speed fans were turned on.

The signal system, installed this past summer, was designed for the Toll Facilities Division, Maryland State Roads Commission, Louis J. O'Donnell, Chief of Division. Design was by J. E. Greiner Company, consulting engineers of Baltimore, Md., James L. Foley, project engineer.



● **FIRST WARNING that drivers encounter when entering the signalized zone is this overhead neon sign, with "SLOW" flashing. The second sign, above right, is neon with a animated arrow. On peak days 55,000 vehicles use the tunnel to bypass Baltimore.**

OPERATING COSTS CUT ONE-THIRD WITH THE LOAD-PACKER 600

Kansas City Contractor Calls Unit Finest He's Ever Owned

"In my 15 years in the refuse collection business," says Charles E. Attebury of Kansas City, "I have never found a better, more dependable packer than the Gar Wood Load-Packer 600."

PLEASED WITH THE SERVICE he receives is Charlie Attebury (right), shaking hands with his Gar Wood-St. Paul distributor, Ernie Pierce of M&E Sales, Kansas City.

Attebury's Load-Packer has allowed him to cut maintenance costs by a third, cut his crew from six men to two, and save 156 man-hours per week. And he did it without any reduction in the size of his route.

In addition to these remarkable savings, Attebury likes the easy loading and dumping characteristics of his new packer. The Load-Packer 600 has the largest, lowest hopper of any 16-yard packer on the market. Crews can handle greater amounts of refuse with fewer packing cycles, saving time, money, and wear and tear on the packer, chassis and engine. And the Load-Packer's telescopic hoist dumping mechanism, a Gar Wood invention, combines fast, positive cleanout with maximum stability.

The Load-Packer 600 is the *one* refuse collection unit that excells in *all* areas of performance—the ultimate in refuse collection efficiency. Start saving money and time right now. See your Gar Wood-St. Paul distributor.

FOUR FEATURES MAKE LOAD-PACKER MOST ECONOMICAL TO OPERATE

Designed into the Load-Packer 600 are four exclusive features that are cutting operating costs for refuse contractors everywhere.

The fast, 10-second packing cycle of the Load-Packer, faster than any competitive body, allows the engine to run at accelerated speeds up to 30% less than other packers.

The big hopper on this machine, 74" wide with a 1½-yard capacity, allows *fewer* packing cycles.

The hydraulic system operates at lower pressures for less strain on the system. And the Load-Packer's exclusive dual volume pump reduces strain on the drive line by 33%.

The simplified design has fewer moving parts . . . less to go wrong. And the controls are so simple they are virtually foolproof, even for inexperienced operators.

GAR WOOD INDUSTRIES, INC.
Wayne, Michigan • Richmond, California

NEWS BULLETINS

AMERICAN PUBLIC WORKS ASSOCIATION, 1313 EAST 60th STREET, CHICAGO 37, ILLINOIS

October 1-7, 1961, Designated National Public Works Week

The American Public Works Association will sponsor again this year a major public education program and will promote the observance of National Public Works Week. The week of October 1-7, 1961, has been designated by the Board of Directors as National Public Works Week.

Heading this year's public education program as chairman of the APWA's Public Relations Committee is William Willis, director, Institute of Local Government, University of Pittsburgh. Other members serving on this important committee include: John G. Duba, Mayor's administrative officer, Chicago, Ill.; James D. Marshall, executive director, Associated General Contractors of America, Inc., Washington, D. C.; Ellsworth G. Maxwell, executive secretary, Board of Public Works, Indianapolis, Ind.; Morris M. Cohn, editor, *Wastes Engineering*, New York, N. Y.; Ray W. Burgess, director, Louisiana State Department of Highways, Baton Rouge; Hugo G. Erickson, coordinator, city of Minneapolis, Minn.; and Rear Admiral James R. Davis, commanding officer, 11th Naval District Public Works Officer, San Diego, Cal.

Kiwanis International, co-sponsor of the 1960 program, will work closely with the APWA again this year in making special arrangements for activities at the local level. The Kiwanis headquarters will be announcing this joint project to its many clubs throughout the United States in the near future encouraging them to participate with public works officials in setting up programs for the observance of this week.

A special memorandum has been sent to the presidents and secretaries of the APWA chapters requesting that special committees be organized to initiate plans for this observance. In those states where there are no chapters, the District Representatives have been requested to appoint a committee.

The principal objectives of such a program will be to foster a better understanding of the importance and function of public works facilities in the community, to enhance the professional status of public works officials in government, and help to attract highly qualified personnel to the field.

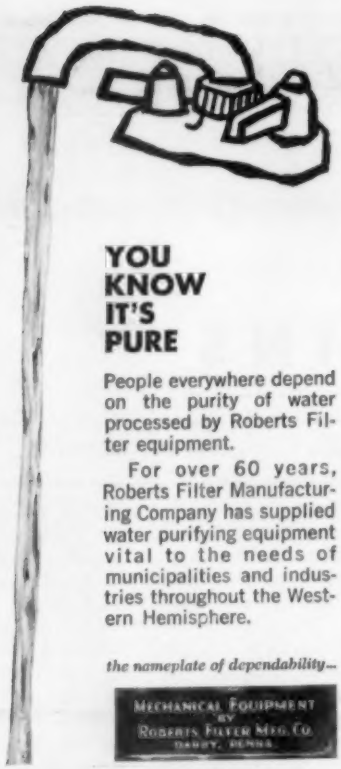
An important element of the program will be the selection of the Top Ten Public Works Men-of-the-Year. Nomination forms containing the rules and regulations governing the eligibility of candidates and the procedure for submitting their names will be available upon request in the very near future.

A full kit of materials will be made available to all persons or organizations interested in sponsoring an observance during the week Oct. 1-7. The kit will contain sample news releases and editorials, sample proclamations to be signed by the mayor, a list of suggested activities such as equipment displays, tours of public works installations, etc., suggested public works films, copies of the national public works seal for color or black and white reproduction, a fact sheet containing material for articles or speeches and other useful items.

The reports and clippings spontaneously supplied following the 1960 program revealed that many communities had very successful programs last year. Outlined below are some of the activities carried out by one community.

1) Mayor's proclamation (signing with press coverage)
2) Establishment of a local Public Works Week committee
3) Editorial—"Fine Public Service"
4) Planned bus tour of public works projects
5) Parade of public works equipment and equipment display
6) High school essay contest. First prize—$50 United States Savings Bond, and four honorable mention awards for $10 each. Pictures and story of winners in local paper
7) Public announcement of major public works projects constructed under the supervision of the Public Works Department during the past 6 years and funds allotted by State Highway Department, Bond Issues and current appropriations
8) Sponsored contest — citizens given opportunity to estimate the dollar value of public works equipment on display. Suitable gift given to person submitting the closest estimate to actual cost
9) Editorial—"Success of our Public Works Week"

OFFICERS: Frederick W. Crane, Buffalo, N. Y., *President;* Albert G. Wyler, New Orleans, La., *Vice President.* REGIONAL DIRECTORS: (term ending 1961) Louis H. Moehr, Wyandotte, Mich.; John A. Morin, Oakland, Calif.; Roy W. Morse, Seattle, Wash.; (term ending 1962) Paul R. Screvane, New York, N. Y.; Manon P. Phillips, Augusta, Ga.; Edward J. Booth, Bismarck, N. D.; (term ending 1963) George J. Maher, Lewiston, Maine; Robert S. Hopson, Richmond, Va.; Harlan H. Hester, Fort Worth, Texas. *Immediate Past President,* Jean L. Vincenz, San Diego, California. Robert D. Bugher, *Executive Director.*


YOU
KNOW
IT'S
PURE
People everywhere depend on the purity of water processed by Roberts Filter equipment.
For over 60 years, Roberts Filter Manufacturing Company has supplied water purifying equipment vital to the needs of municipalities and industries throughout the Western Hemisphere.
the nameplate of dependability—
MECHANICAL EQUIPMENT BY ROBERTS FILTER MFG. CO. DARBY, PENNA.
ROBERTS FILTER MANUFACTURING COMPANY
640 COLUMBIA AVENUE, DARBY, PA.

A DEPENDABLE BUYING SOURCE

power sweeper refill fibres

Wide variety of domestic and imported fibres. Large or small filled immediately from huge warehouse stock.

gutter wire

Tough and durable. In guages and lengths to suit your needs. Write or call VAndyke 2-0867 for prompt Steiert service.

A. STEIERT & Son, Inc.
Hatfield, Penna.

10) Special dinner to mark close of Public Works Week with a prominent authority speaking
11) Numerous articles in the local paper

APWA To Define Solid-Waste Research Projects

The membership of the American Public Works Association adopted a resolution at its last annual meeting requesting the Department of Health, Education and Welfare to establish a broad program of basic and applied research in the field of municipal solid waste collection and disposal. Steps have recently been taken by the Division of Engineering Services of the Public Health Service to implement this important recommendation.

APWA Executive Director Robert D. Bugher has announced that the sum of $6,500 has been made available to develop a report delineating specific research projects in the field of solid wastes storage, collection and disposal methods. The report will include a statement of the problems and their technical, economic and health implications and suggest research approaches which promise feasible solutions. Also to be included, is information on individuals, universities and other organizations who are interested in, and competent to conduct research work on refuse collection and disposal problems.

The resolution adopted by the APWA membership pointed out that the cost of collecting and disposing of community solid wastes amounts to about $1.5 billion dollars per year and that a broad program of research is definitely needed in this important field of activity.

Crane Appoints 1961 Committees

Chicago, Ill. — APWA President Frederick W. Crane announced recently appointments to several of the Association's important committees. These committees are responsible for handling or overseeing many of the projects sponsored by the APWA and play a vital role in carrying them to completion. Committee appointments or re-appointments for five of the Association's committees are listed below. Others will be announced at a later date.

Group Life Insurance Study

Edward P. Decher, executive director, Joint Sewer Commission, Newark, N. J., has been appointed to serve as chairman of the committee established to investigate the possibility of offering a group life insurance plan to members as an added membership service. Named to serve with Mr. Decher are: S. G. Gentile, deputy commissioner of the Department of Public Works, Detroit, Mich.; Richard Fenton, assistant to director of operations, Department of Sanitation, New York City; Robert C. Garnier, city personnel director, Milwaukee, Wis.; Dale N. Garst, director, Department of Sanitation, Wichita, Kans.; and Harlan H. Hester, street superintendent, Fort Worth, Texas.

Resolutions

Louis L. Drasler, director, Department of Public Service, Cleveland, Ohio, has been appointed chairman of the Resolutions Committee. Other newly appointed members include: Sam B. Ward, city engineer, Denver, Colorado; J. D. A. MacDonald, city engineer, Edmonton, Alberta, Canada; Karl B. Stalling, director, Department of Public Works, Nashville, Tennessee; and Frederick W. Crane, general manager, Buffalo Sewer Authority, Buffalo, New York (Ex-Officio).

All the resolutions scheduled for presentation at the annual meeting of the Association are referred to the Resolutions Committee for its recommendation. No action is taken on a proposed resolution without consideration of the Committee's recommendation.

Aid-to-Education Award

The new member appointed to serve a three-year term on The American City Magazine Aid-to-Education Award Committee is Fred Glendening, public works director, Phoenix, Arizona. E. L. Filby, consulting engineer with the firm of Black and Veatch, Kansas City, Mo., assumes the chairmanship this year as the senior member of the committee and Arthur D. Bird, Engineering Division, Cincinnati, Ohio, will serve his second year of his three year term. This award is intended to provide financial assistance to deserving senior students and graduates of accredited engineering schools who wish to continue their education in preparation for careers in the public works field. The assignment of the committee is to select the recipient on the basis of a rating system as outlined in the official regulations.

Transportation

John Bailey, executive director, Urban Transportation Study Board and Deputy managing director of the City of Philadelphia, will continue to serve as Chairman of the Committee on Transportation.

2 NEW FITCHBURG CHIPPER FEATURES

Give Your Engine Longer Life
Save Gas, Add Safety

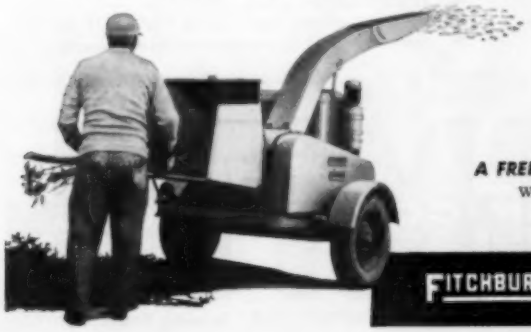
1 **EXTRA PROTECTION** for your crews with this NEW SAFETY STOP SWITCH that stops all moving parts of the chipper within seconds. Switch is within easy reach at rear so operator can flip it without moving from feed position. An important new feature of the Fitchburg Chipper, *already considered safest* because it has no hard-to-control flywheel.

2 **GREATER ECONOMY** with this NEW SOLENOID SWITCH* which allows the operator to quickly idle the motor between actual brush feedings. With the motor idling, you save on gasoline and engine wear; and there's less noise, which pleases the public. Your operator can use the switch easily because it is at the rear and handy.

CHIPPING IS SMOOTHER and faster with a Fitchburg because of its exclusive *spring activated feed plate.* This patented feed plate "gives" *automatically* under pressure. You can chip even large limbs (up to rated capacity) without killing the engine. And your crews are safer because the feeding action is more positive, smoother, with less whipping of the brush.

CHIPPING IS MORE EFFICIENT with a Fitchburg. The exclusive feed plate allows wood to be chewed up in small bites. This takes less power, and the engine can be run at lower r.p.m.—which is more efficient, saves you gas and cuts engine wear.

TROUBLE-FREE Fitchburg Chippers stay out of your shop so you don't lose valuable man-hours. These rugged machines are the choice of tree surgeons, line clearance contractors and others—men who depend on Chippers day after day to make money. Blades are made from special alloy steel to hold a keen edge for a long time, even with hard use. Fitchburg Chippers are well-engineered, come in four sizes to meet your needs: the largest handle limbs as thick as seven inches with ease.



A FREE BOOK "Chip Dollars" should be in your hands if you deal with brush disposal. 20-pages. Write for free copy — Dept. PW-15.

*optional equipment

FITCHBURG ENGINEERING CORPORATION FITCHBURG, MASS.

Established in 1960, the committee remains unchanged with the exception of the addition of Kenneth M. Hoover, chief engineer of the San Francisco Bay Area Transit District. Other committee members are: Fred J. Benson, director, Texas Transportation Institute, College Station, Texas.; Edward M. Hall, street improvement administrator, Phoenix, Ariz.; E. E. Lewarch, traffic engineer, Seattle, Wash.; Eugene Maier, director, Department of Public Works, Houston, Tex.; Grant D. Mickle, director, Traffic Engineering Div., Automotive Safety Foundation, Washington, D. C.; Glenn C. Richards, commissioner, Department of Public Works, Detroit, Mich.; C. G. Stoneburner, highway engineer, Arlington County, Va.; Albert G. Wyler, director of streets, New Orleans, La.; and David Schoppert, highway transport engineer, Automotive Safety Foundation, Washington, D. C.

Central California Chapter To Sponsor Annual Scholarship

The Central California Chapter of the American Public Works Association has entered into an agreement with the Fresno State College Foundation to make available an annual $100 scholarship to a student majoring in engineering, public administration, business administration, or industrial technology. The first presentation of this award will be made in May.

The scholarship is to be awarded to an upper division student (not a senior) at Fresno State College. The selection will be made by a Committee on Scholarships. Applicants must indicate an intention to enter the field of public works. The recipient will be invited to attend the chapter's public works meetings regularly as a guest and will receive the Association's News Letter.

APWA Sponsors Seminar On Urban Transportation

"Planning and Programming Urban Transportation Improvements" will be the subject of discussion at an American Public Works Association's regional seminar to be held in Richmond, Virginia, May 17 and 18. The seminar is being sponsored by the APWA's Transportation Committee headed by John A. Bailey, executive director, Urban Transportation Study Board, and deputy managing director of the City of Philadelphia.

The two-day seminar will cover such topics as: Organizing for the job; system classification and standards; getting the facts; forecasting and the land use plan; developing the transportation plan; determining program and priorities; gaining public support; and keeping the plan up to date.

The seminar is keyed particularly to the needs of the public works director in the medium and smaller-sized community. However, city administrators, urban planners, city engineers, traffic engineers, and representatives of county, state and federal agencies can all benefit from the meeting. The best current approaches, proven in actual practice, will be presented at the seminar by experienced engineers. Presentations will be made through talks, panels, and demonstrations. Time will be provided for questions and comments from the floor and the exchange of ideas in small group discussion. The seminar is designed to help local officials keep abreast of new, improved techniques of planning and programming.

The Automotive Safety Foundation has made available a $2,700 matching grant to the American Public Works Association to be used to help finance a series of seminars to acquaint public works officials with the need for urban transportation planning techniques. Information regarding other seminars of this type will be announced later.

"Hardrock Smitty" says:— **IT TAKES A SMITH 125 AIR COMPRESSOR TO DELIVER ON THE TOUGH JOBS . . .**

Built to "take it" when the going get tough, the Smith 125 Air Compressor will give you years of low cost, dependable service. The Rugged Hercules Industrial engine delivers over 125 c.f.m. hour after hour, day in and day out.

LOOK AT THESE FEATURES:

- low initial cost
- low operating cost
- easy maintenance
- simple, compact design
- 12 volt electrical system
- 125 c.f.m. at 1165 rpm
- operates two 85 lb. paving breakers at same time

Compare price . . . compare job results—you'll "Go Smith" with "Hardrock Smitty"!

There's also a complete line of Smith Air Compressors in 45 cfm and 75 cfm models, both portable and stationary.

Ask your dealer for an "on the job" demonstration. (write us for complete information and the name of your nearest dealer.)

SMITH AIR COMPRESSORS

GORDON SMITH & COMPANY, INC., Bowling Green, Ky.

7,800 FEET–660 SEPARATE CUTS A DAY!

THIS CLEVELAND J TRENCHER digs 30 house footings per day for Contractor J. C. Bowles in Dairy City, California. Each house requires 260 lineal feet of trench—22 individual cuts—which means: 660 machine moves, 660 boom hoistings, 7,800 feet of digging every day. Such performance shows these Cleveland J features pay off:

- **100% control of all operations at the operator's fingertips**
- **Full visibility for the operator**
- **Fast, full-range positive boom hoist**
- **Independent conveyor speeds to 1,000 feet per minute**
- **Big 16" x 3" hydraulic steering brakes**
- **100% anti-friction-bearing track components**
- **1,000-hour track lubrication**
- **Bushed, 1½" hardened track pins**
- **Dual track drive and support for maximum stability**
- **All speeds available in either direction**

"No other machine does this work so fast and so cheap and gives you such a clean finished job," says Bowles. He should know. His crews have dug footings for more than 100,000 houses in the last 10 years.

CLEVELAND TRENCHER

THE CLEVELAND TRENCHER CO., 20100 ST. CLAIR AVE., CLEVELAND 17, OHIO

THE HIGHWAY AND AIRPORT DIGEST

Prepared by **L. G. BYRD,** *Associate Editor*

Subgrade Drainage

Design of subgrade drainage begins with consideration of roadway cross section and available materials. A minimum 12-in. layer of impervious subgrade material in the top of the road bed acts as a seal both from the top and bottom—to seal off ground water and to act as an impervious surface over which water leaking through the pavement will flow out of the road bed. Above the subgrade and below the pavement, a stable, granular layer of pervious material acts as a drain to carry off moisture. Where the ground water table is higher than the elevation of the road profile, side ditching may be employed to lower ground water or perforated underdrains installed. The underdrains are preferably located adjacent to, but not under, the pavement. They will effectively dewater an area about 10 to 15 ft. on each side of the pipe. Where water-retaining gumbo clays are encountered they must be removed and replaced with drainable material. The complexities of design requirements for the Interstate system tend to make these principles an oversimplification, but the basic practices remain applicable.

"A Practical Approach to Subgrade Drainage, Part 2 of 2." By John M. Wilkerson, State Road Design Engineer, Georgia State Highway Department. *Highway Magazine*, March, 1961.

Science of Signing

An important phase of the growing science of highway engineering is the field of highway signing. In the State of Washington alone, there are over 60,000 traffic signs on state highways. The basic characteristic of the modern sign is its size. High speeds require large signs with maximum legibility. An example of modern signing is the exit direction sign series required on freeways. The first sign, 3 or 4 miles from the exit is the advance destination sign. The second, at about one-half mile before the exit, is a directional arrow and distance sign. The third and fourth signs flank the entrance to the exit lane and show the exit speed and two directional arrows. The "trail blazer" signs, used to direct travelers onto interstate routes, are patterned after the toll road "lead-in" signs. Tourist facility signs, advising travelers of available facilities at the next interchange, are another necessity of modern highway travel.

"The New Science of Signing." *Highway News*, March-April, 1961.

Asbestos in Asphalt

Findings indicate that the flexural strength of standard, open-graded binder mixes of asphaltic concrete is increased ten times by the addition of 2½ percent asbestos. Two improvements are made in asphalt surfaces: 1) Long term stability and 2) load distribution characteristics. Unique weathering ability is derived from use of asbestos fibres which inhibit ravelling and extend service life. Marshall stability ratings average 25% higher for mixes using 1.7 to 2.5 percent short asbestos fibres. Numerous test installations are undergoing observation on airfield runways and street and highway surfaces.

"Is Asbestos in Asphalt the Answer?" *Roads and Engineering Construction*, (Toronto, Canada), February, 1961.

Control of Pavement Cuts

Topeka, Kansas has developed a plan for securing satisfactory street repairs following work on drains and utility lines. The city engineer issues a permit for all such work contingent upon the meeting of several rigid requirements. The permit holder must post a bond guaranteeing the street repair for a period of two years. Earth excavation must be replaced at optimum moisture content and compacted to 100 percent of AASHO density. A pavement base course of low-slump concrete is required. Bituminous surfacing is then replaced with a hot-mix asphaltic concrete. Two inspectors work full-time checking these projects during the construction season and no significant work is permitted except in the presence of an inspector. Results of the program have been excellent with additional corrective work by city forces seldom being required.

"How Topeka Controls Pavement Cuts." *Street Engineering*, March, 1961.

Rigid Pavement Design

The major factor which is considered in the design of rigid pavements includes building a concrete slab sufficiently thick to reduce stresses that might result from the loads imposed on it. The design and judicial placing of joints and steel reinforcement is important. Subgrades and subbases affect the performance of the pavement appreciably, and care must be taken to insure that they are adequately designed. Subbases are used under rigid pavements for a variety of reasons, including control of pumping, control of frost action, drainage, control of high-volume change soils, provision of a working platform on which to place the concrete slab, and for increased structural capacity. The subbase must be properly compacted to insure that settlement will not result. Uniformity of supporting power under a rigid slab is extremely important.

Rigid airport pavements are gen-

Fast-growing city finds Michigan mobility, digging power, versatility pay off -- BIG!

Keep work-hours same, service same despite doubling of population

Although the City of Pomona, California, has doubled its population in the past seven years (from 35,000 to 70,000), it still effectively operates its Street Maintenance & Repair Dept with the same number of men it used seven years ago.

The big difference is in machines and methods . . . two mobile, hard-digging, versatile Michigan Model 75A Tractor Shovels today do the work once done by fleets of slower machines and sizeable work-crews. For example . . .

Street repair . . .

Among the many assignments given the 1¼ yd Michigans has been breaking out and truck-loading of old concrete pavement. Because previous loaders lacked Michigan's powerful pry-out, this job formerly required drills, air compressors, sledgehammers and many man-hours. Now, Michigans do *all* the work, reducing costs per average job 50%, man-hours 50%.

Refuse disposal . . .

Landfill dozing once required a crawler plus a lowboy for transportation. Today, Michigan with its fast, self-powered travel (up to 28 mph) and fast dozing, has halved the time spent handling daily coverage. Unit drives over city streets to the dump . . . quickly levels, compacts and covers refuse . . . then drives on to other assignments.

Loading decomposed granite . . .

Another major job for the Michigans is to excavate and truck-load pit-run material for street repair. Tight rock structure made excavation almost impossible with previously-owned tractor shovels. Michigan's rugged construction and powerful pry-out, however, successfully gouge out 1¼ yard bucketfulls of the decomposed granite (note photo). Typical 5 yard truck-loads take only 2 minutes.

Cleaning storm drains . . .

Mucking out storm drains was another job formerly reserved for a crawler dozer (or motor grader) and a front-end loader. Today, one Michigan does both tasks—dozing and truck-loading the waste material at a saving of over 50% in time and machine cost.

Operation costs only $2.02 hourly

Overall operating costs of both the 3-year-old and the newer 1½-year-old Michigans are surprisingly low. Fuel, oil, tires, maintenance, repairs—all costs, in fact, except depreciation and operators' wages (which are figured under a separate budget)—add up to only $2.02 per machine per meter hour!

"We're *more than pleased* with Michigan dependability too," reports Shop Foreman Thomas Cooke, Jr. "In 4½ combined work years, we've lost no work time due to major breakdowns . . . and we find the Michigans especially easy to service and repair."

Michigan is a registered trademark of

CLARK EQUIPMENT COMPANY
Construction Machinery Division

CLARK® EQUIPMENT

2499 Pipestone Road
Benton Harbor 26, Michigan

In Canada:
Canadian Clark, Ltd.
St. Thomas, Ontario

Problem:

HIGHWAY WEEDS

Answer:

AMCHEM

AMIZINE

WEED KILLER

(and AMIZOL combinations)

Complete vegetation control is the result when you use Amizine along roadsides, guard rails, gravel shoulders, bridge abutments, center strips and embankments.

Apply Amizine any time weeds are actively growing. One treatment in spring or early summer controls most broadleaf weeds and grasses for the entire season. Amizine applies easily, won't corrode spray equipment, is non-inflammable and odorless . . . won't stain metal, stone or concrete.

Other combinations of Amchem Amizol also provide total vegetation control, are highly effective on deep rooted perennials. Economical, too. Check them both—Amizine and Amizol—sure death on highway weeds!

AMCHEM **AMIZINE**

Amchem, Amizine and Amizol are registered trademarks of
AMCHEM PRODUCTS, INC. (Formerly American Chemical Paint Co.)
AMBLER, PA. • St. Joseph, Mo. • Niles, Calif.

AMCHEM PRODUCTS, INC.
AMBLER, PA.

Please send me free folder on Amizine, the general weed killer for highway weed problems.

NAME_____ TITLE_____

CO. OR DEPT._____

ADDRESS_____

CITY_____ ZONE_____ STATE_____

erally designed using variable thicknesses, depending upon the modulus of subgrade reaction and type of applied load. In contrast, rigid highway pavements are generally built to arbitrary thicknesses based upon past experiences. Thicknesses of rigid highway pavements range between 6 to 10 inches. Major interstate highways may be as thick as 10 inches, whereas, secondary roads can be as little as 6 inches. The proper selection and placement of subbase material under the rigid pavement is essential. Open graded subbases are generally recommended wherever feasible, but dense graded materials are used sometimes due to type of material supply. Open graded, drainable subbases should be built in such a manner as to permit free drainage of surface infiltration whereas dense graded bases are often constructed in a trench.

"Basic Principles of Pavement Design, Part 2—Rigid Pavements." By E. J. Yoder, Associate Professor of Highway Engineering and Research Engineer, Joint Highway Research Project, Purdue University. PUBLIC WORKS, April, 1961.

Culvert Life

To provide designers with preliminary information on expected performance of metal culvert installations, the California Division of Highways evaluated over 12,000 corrugated metal culverts in the State. While the investigations indicated that service life of existing culverts is the best criterion for estimating performance of new installations, a test method was developed and is now in use by the Division. The method is based on the environmental factors influencing corrosion. Soil bacteria, indicated by hydrogen sulfide gas in the soil and limited to areas of high rainfall or ponded water, increase the corrosion rate. The presence of corrosive salts, indicated by low electrical resistivity of the soil, cause deterioration of the metal pipe by chemical and electrical action. The hydrogen-ion concentration or pH of the soil affect the corrosion rate, the higher rates being in the acid soils. The corrosion rate is described as the time to perforation for 16 gage galvanized culverts, acknowledging that this is not necessarily a measure of useful life of the pipe. Using the electrical resistivity and pH of the soil as measures of environmental factors a chart is developed to indicate years

310,000
LANDINGS AND TAKE-OFFS IN 1959!

On twenty-year-old runways paved with

CHEVRON ASPHALT

Back in 1940, Warren Bros. Company, Contractors, built these runways to Federal Specifications. They built them to last—with Chevron Asphalt!

Washington National Airport, noted for unobstructed approaches, is a 667 acre area located at a wide bend of the Potomac River. It has served during what must be regarded as the most hectic and active two decades of the air age!

As traffic handled at the airport increased over the years, the original paving has been added to and widened. The present pavement is equal in area to 30 miles of four-lane highway!

In 1953, the runways were sealed with BITUMULS RS-2 and clean, specially graded aggregate. This is the story of service, the story of *asphalt* service on an airport carrying an exceptionally heavy traffic load.

For information or typical specifications on runway construction, or on any type of paving, with Chevron Asphalt or Bitumuls Emulsified Asphalt, call our nearest office.

American Bitumuls & Asphalt Company
320 Market St., San Francisco 20, Calif.

Perth Amboy, N. J.
Baltimore 3, Md.
Cincinnati 38, Ohio
Atlanta 8, Ga.
Mobile, Ala.
St. Louis 17, Mo.
Tucson, Ariz.
Portland 8, Ore.
Oakland 1, Calif.
Inglewood, Calif.
San Juan 23, P. R.

BITUMULS® Emulsified Asphalts • CHEVRON® Paving Asphalts • LAYKOLD® Asphalt Specialties • PETROLASTIC® Industrial Asphalts

to perforation. The perforation time for metal thickness of a gage other than 16 is assumed to be a direct ratio of the thickness. The use of protective coatings indicate an average increase in protection from corrosive flow of six years and in protection from corrosive backfill of 25 years. Paving of the invert may add up to 20 years of protection from corrosive flow.

"Culvert Life." By John L. Beaton, Supervising Highway Engineer and Richard F. Stratfull, Associate Materials and Research Engineer. *California Highways and Public Works*, January-February, 1961.

Equipment Location Map

Clearing snow in the Texas Panhandle District 4 is a major operation. Because economics require a relatively small equipment fleet, it is important that each unit be used efficiently and effectively during storm periods. To insure this type of performance a central coordinator at the district office maintains radio contact with the seven district base stations and 65 mobile two-way radios in the snow removal equipment and foremen's cars. To maintain a visual record of the overall situation during a storm, a plastic-covered magnetic map board is mounted in the radio room. Various types of equipment are represented by color-coded magnets and spotted on the map as their areas of operation are reported. Road surface conditions are marked on the map with colored grease pencils. Reassignment of major equipment, reporting of roadway conditions and transfer of information to incoming personnel are all made more accurate and reliable through the use of the map record.

"Equipment Location Map." By Richard C. Crandall, Senior Laboratory Engineer, District 4. *Texas Highways*, March, 1961.

Other Articles

"Maintenance of State **Highway Shoulders.**" Well-established blading routines, periodic replacement of aggregates and stabilization of problem areas keep Wisconsin's highway shoulders in excellent condition. By C. E. Aten, Engineer of Maintenance, Wisconsin State Highway Commission. PUBLIC WORKS, April, 1961.

"Planned Maintenance Knows No Off Season." Seasonally scheduled maintenance procedures are a necessity for modern highways. By Edward D. Reilly, Associate Engineer, Maryland State Roads Commission, Baltimore, Maryland. PUBLIC WORKS, April, 1961.

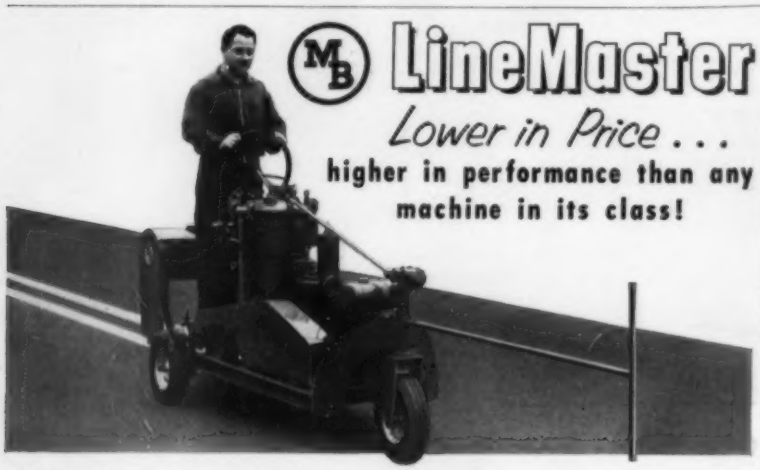
"Chicago's Rail **Rapid-Transit Line** in the Congress Expressway." The new expressway has provisions for additional tracks to be installed when the need develops. By V. E. Gunlock, Chairman, Chicago Transit Authority, Chicago, Ill. Civil Engineering, March, 1961.

"Installation of a **Two-Way Median Left Turn Lane.**" Sacramento County, Calif., is well satisfied with the first year of operation of this type of traffic control. By James C. Ray, Traffic Engineer, Sacramento County, Calif. Traffic Engineer, March, 1961

"The **Future of Highways** and Highway Transportation." An address by D. C. Greer, Texas State Highway Engineer before the Pacific Regional Conference, International Road Federation, Sydney, Australia. Texas Highways, March, 1961.

"Highways Can Be Safe Ways." Improvement of presently inadequate streets and highways can be accomplished with better lighting, marking and traffic control. By Ernest F. Siegel, Ernest F. Siegel & Associates. Consulting Engineer, March, 1961.

"Highway Construction: An **Employment Generator.**" An analysis of the on-site employment of 48,000 men generated by each billion dollars of Federal-aid highway construction. By M. B. Christensen, Chief, Construction and Maintenance Division, and David A. Gorman, Highway Engineer, U. S. Bureau of Public Roads. Public Roads, April, 1961.



M-B LineMaster

Lower in Price . . .

higher in performance than any machine in its class!

- Rapid single or double-line marking, 1 color, 3" to 6" widths, regular or reflective, solid or intermittent.
- Automotive-type steering and Shift-o-matic drive for effortless operation.
- Self-propelled, one-man operated with striping speeds of 3 to 5 mph.
- Big 18 gallon paint tank and heavy-duty jet spray cups for sharp, clean stripes.
- Built-in riding platform affords operator unmatched visibility.

Write today for information on the complete M-B line of markers with paint capacities from 10 to 750 gallons. M-B Corp., New Holstein, Wisc., Dept. PW

M-B CORPORATION

LINE MARKERS • PACKER BODIES SWEEPERS

QUALITY MUNICIPAL AND INDUSTRIAL EQUIPMENT SINCE 1905

NEW MINIATURIZED WILKINSON LINE LOCATOR

MODEL W-3

Radically new, powerful, transistorized locating instrument weighs only 4 lbs. and is ¼ as large as old type pipe locators.

Telescoping aluminum handle; 2 oz. single ear set; all in carrying case.

Write today for brochure and instruction manual.

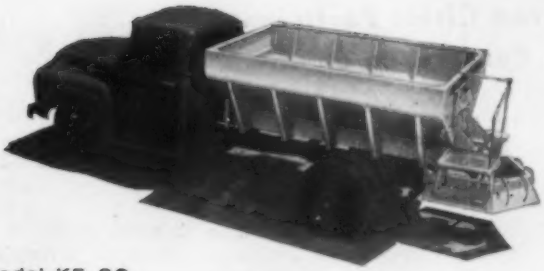
WILKINSON PRODUCTS COMPANY *Since 1940*

3987 Chevy Chase Dr., Pasadena 3, Calif. SYlvan 0-4314

BAUGHMAN HAS THE RIGHT ICE CONTROL EQUIPMENT

**FOR ANY SIZE JOB...
FOR ANY SIZE BUDGET**

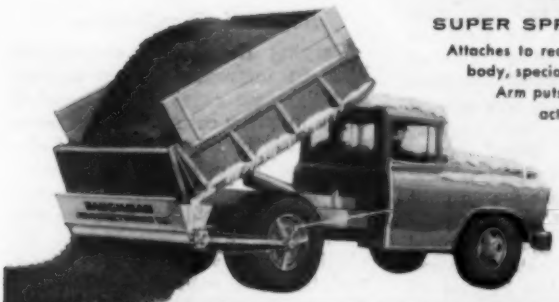
Because snow and ice control problems vary with community size and geographical location, Baughman offers a line of spreaders with a wide range in price and capacity. This greater selection means that you can be sure of getting the exact equipment for your needs—and in line with your budget.



Model K5-SC
First choice of many street and highway departments.

DUMP BODY MOUNTED SPREADER
Fits into dump body, frees truck for other duties when not needed.

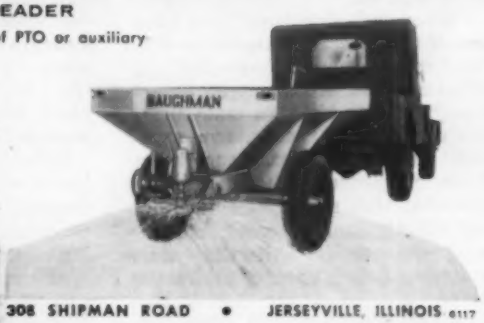
SPREAD-MOBILE
Exclusive Center-Spread discharges under all four wheels.



SUPER SPREADER
Attaches to rear of dump body, special Stabilizer Arm puts truck into action faster.

Model SC-52
Mechanized spreading for the lowest possible price.

SAFETY SPREADER
Pull-type, choice of PTO or auxiliary engine.



***BAUGHMAN IS THE WORLD'S MAJOR MANUFACTURER OF ICE CONTROL EQUIPMENT** Better service through better engineering. Parts and service from 200 dealers.*

Additional choice dealerships are available.

BAUGHMAN MANUFACTURING CO., INC.

308 SHIPMAN ROAD • JERSEYVILLE, ILLINOIS 6117

Seven Cities Participate in Conference on

Urban Snow Removal

CURRENT PRACTICE in snow removal and potential improvements of service were discussed by experts from seven cities at the 1961 Round Table Conference on Urban Snow Removal held in New York City on March 23 and 24. This conference, believed to be the first of its kind ever convened, was sponsored jointly by the Department of Sanitation of the City of New York and the Board of Commissioners of the District of Columbia. Participating municipalities were New York, Washington, Baltimore, Boston, Buffalo, Philadelphia and Pittsburgh.

It was the aim of the conference to share experiences gained during the unusually severe snow storms that struck the northeastern section of the country during the winter of 1960-61. While a review of mutual problems disclosed many special conditions of purely local nature, it is believed that this study of organization and operations will enable each municipality to do a better job when required to combat future storms.

Yearly, urban economies become more and more dependent upon motor vehicles. When heavy snows prevent movement of traffic, disaster conditions ensue. Therefore it is the first aim of all snow emergency plans to keep arterial routes open for the movement of essential traffic and public transportation. As a next step, snow is physically removed from streets in the main business districts and at bus stops. Some cities, notably New York and Boston, continue plowing operations until all streets have been opened to insure access of vehicles for fire protection and delivery of oil and other supplies.

Parked and abandoned cars form one of the greatest obstacles to efficient snow removal. To combat this situation most cities impose emergency parking bans on main thoroughfares and in downtown areas until plowing and clearing work has been completed, although it was conceded that such restrictions are not effective unless accompanied by a severe penalty. Otherwise some motorists find it cheaper and easier to pay a nominal fine than to hire a private towing vehicle when they become stuck in an area where parking is restricted.

Emergency Snow Plans

To combat the traffic paralysis of heavy snow storms, city forces must be organized to provide public information, to operate plowing and spreading equipment on predetermined routes and to maintain communications with work crews, enforcement agencies and utilities. In Baltimore, for instance, the following items form part of that City's Snow Emergency Plan: Designated arterial routes are posted with temporary signs which ban parking. All vehicles traveling these routes are required to have snow tires or chains. The police department assigns personnel to more than 500 stragetic intersections and mans its fleet of impoundment trucks in readiness to tow stalled cars as necessary. Representatives of all affected city departments go on duty at a storm emergency center, from which communications are maintained by radio with field forces and by direct telephone line with the local utility company. Since all information is channeled through this center it is prepared to keep local broadcasting stations and the press constantly alerted to the progress of the storm and snow plowing operations. Also, citizens' requests for emergency service are routed through this center so each request or complaint can be passed immediately to a representative of the appropriate department for prompt action.

The most radical traffic control measure used to facilitate snow removal was the complete ban on all traffic declared by New York City following the last severe storm of the season. Under this emergency measure trucks and private cars were stopped at all entrances to the city. Trucks were later permitted entry but the ban on private cars remained in force for several days.

Great stress was placed on the importance of timely and accurate forecast information and advance warning to the public of approaching storm conditions. In addition to Weather Bureau and private forecasting services used by many cities, Washington, D. C., maintains contact through its Civil Defense center with areas to the west and south of the city so that spot checks can be made of the severity of approaching storms. This plan has provided helpful and reliable data.

Several cities have plans whereby employees are dismissed early or at staggered hours. In the case of Washington, Federal government employees are dismissed early under one of the established snow emergency plans. Baltimore has divided the city into five sections and has requested that employers dismiss workers at half-hour intervals to spread out the traffic load. This new plan, which operates on a voluntary basis, gave good results when tried last winter. A difficulty of such plans is the inflexibility of public transit schedules.

Another new idea presented by Baltimore is the proposed establishment of special signs which would ban parking or travel without snow tires or chains on emergency snow plowing routes. These would be hinged and would remain closed, with the message covered, until the approach of a storm. Then they can be opened quickly to display their message, and later closed promptly following the completion of snow plowing and removal operations. It was noted by all representatives that merchants object strongly to protracted parking bans after business areas are cleared of snow, but no one reported a means of lifting parking bans piecemeal following block-by-block removal work.

Regional Coordination

Varying degrees of cooperation between metropolitan communities and the core cities were reported. Since in every case there is a heavy traffic flow between the central city and the suburbs, snow plowing operations will lose effectiveness if traffic gets bogged down at the city line. Suburbs of Washington, including county and state forces, maintain a tie with the city through their communications network and have adopted the same sequence of snow emergency plans used by the city. An area for improved service would be the adoption of uniform regional plans for use in snow emergencies.

Equipment Contracts

With the exception of Buffalo, all cities reported the use of hired plows, trucks and loaders to supplement city-owned equipment. Most contracts are based on hourly rates for equipment and labor, though Boston and New York City

In city after city across the USA

The story is the same...

PRISMO PLASTIX "SD"

BY POPULAR DEMAND!

More and More Traffic Engineers are recognizing rugged, long-wearing Prismo Plastix SD as THE answer to the need for a material to stand up in high density locations. They praise Prismo Plastix for the ease and speed with which it goes down and molds to the pavement, for its resistance to dirt, wear and moisture, for its immediate reflectivity and amazing durability, its versatility of shapes and sizes, its basic economy and low maintenance cost.

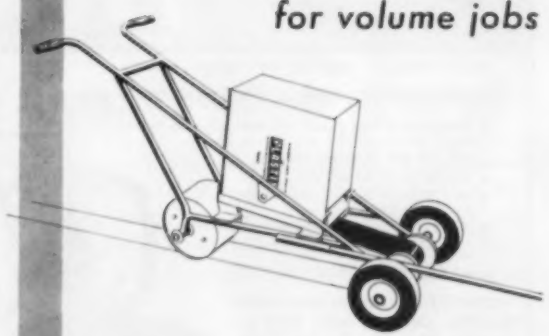
PRISMO

PRISMO SAFETY CORPORATION
Huntingdon, Pennsylvania

and now...**THE WALD**

PLASTICATOR

for volume jobs



Makes continuous application of solid line Plastix easier than painting. In one application it peels, then presses the markings into firm position. Saves time, insures a straight, neat job.

also contract for snow removal on the basis of a fixed price per cubic yard of snow removed. Hired tow trucks are an important group to be considered since parked cars are the most serious detriment to efficient plowing and loading operations.

Residential Streets

The parking situation makes effective plowing of residential streets impossible in most cities. Especially where parking bans are rigidly enforced on arterial routes, the tertiary streets are likely to have many double-parked cars. Some clearing operations on a neighborhood basis were noted by Washington and Philadelphia. In the former city, residents may arrange to have all cars off one side of the block, after which city forces will plow the block. This service is provided within a 4-hour period after notification and has worked to the satisfaction of all concerned. In Philadelphia, neighborhood groups are permitted to clear streets by opening a sewer manhole. Philadelphia has also experimented with the use of small crawler tractors to backdrag blades for snow compaction in narrow streets but has not found this method to be very successful.

Snow Disposal

Suitable disposal sites for snow removed physically from downtown business areas are becoming increasingly difficult to find. Even New York City, with its miles of waterfront, finds this to be a problem as new pier facilities and waterfront parks are developed. This factor, coupled with the increasing cost of snow loading and trucking, has awakened interest in the use of snow melting equipment. Mobile snow melters under consideration have a rated capacity of about 75 tons per hour. Snow removal costs in New York City are now about $1.50 per cubic yard and continue to rise. Since the cost of fuel is relatively constant the use of melters becomes economically attractive.

Conclusion

In a joint statement, co-chairmen Frank J. Lucia, Sanitation Commissioner of New York City and Brigadier General Frederick J. Clarke, Washington Engineering Commissioner said:

"None of us will go home with the solution to the complex problems of our individual cities. But all of us have been stimulated by this fresh examination and will take away many ideas which now must be evaluated with a view toward application to each city's particular set of snow-removal problems.

"This applies especially to traffic during and after major snowstorms. Innovations such as the traffic ban imposed by Mayor Wagner of New York in February seem certain to receive important consideration.

"We are all concerned with the necessity of obtaining compliance with parking bans to permit plowing operations, and consider that heavier penalties seem to be the most effective way of resolving this problem.

"We agree that the public should be made increasingly aware of its responsibilities in snow emergencies. In this area, the requirements as regards the clearing of sidewalks by householders is a concern. So are efforts directed at motorists' non-essential driving during storms, and their need for skid chains, snow tires, and instruction in driving techniques in snow situations.

"After this highly productive first conference, it is our hope that we can meet again next year to report progress, and to continue this free exchange of ideas calculated to improve snow-removal operations and techniques everywhere."

CUTS WEEDS • MOWS LAWNS • MULCHES LEAVES

The rugged

ROOF *VP* MOWER

Nearest thing to power-steering in a heavy-duty mower!

The new Roof Swivel-Glide mower is engineered to handle all heavy duty mowing requirements from heavy weed and brush cutting to spacious lawn areas.

COMPARE THE FEATURES . . . WEIGH THE FACTS

- **VARIABLE PITCH BLADE ACTION** provides instant blade adjustment for any cutting job
- **26" OR 30" CUTTING WIDTHS**
- **OIL BATH GEAR DRIVE**
- **26" WHEELS** for greater traction and maneuverability
- **CHASSIS** is heavy gauge prime sheet steel reinforced and welded into one rugged unit
- **CHOICE OF ENGINES** 4 to 7 H.P.

VERSATILITY, MANEUVERABILITY AND RUGGED, LONG LIFE MAKE ROOF VP MOWERS YOUR BEST BET FOR YEAR-ROUND MAINTENANCE

Choice of 26" or 30" Cutting Widths

For FREE FACT FOLDER write:

ROOF MANUFACTURING CO., Pontiac 12, Ill.

BUILT TO "take it"

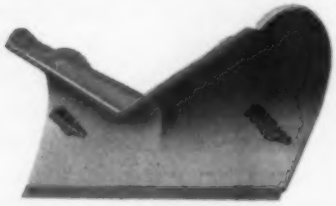
WAUSAU PRODUCTS

The WORLD'S MOST COMPLETE LINE of SNOW REMOVAL EQUIPMENT!

Now Introducing the REVOLUTIONARY

NEW EXPRESSWAY

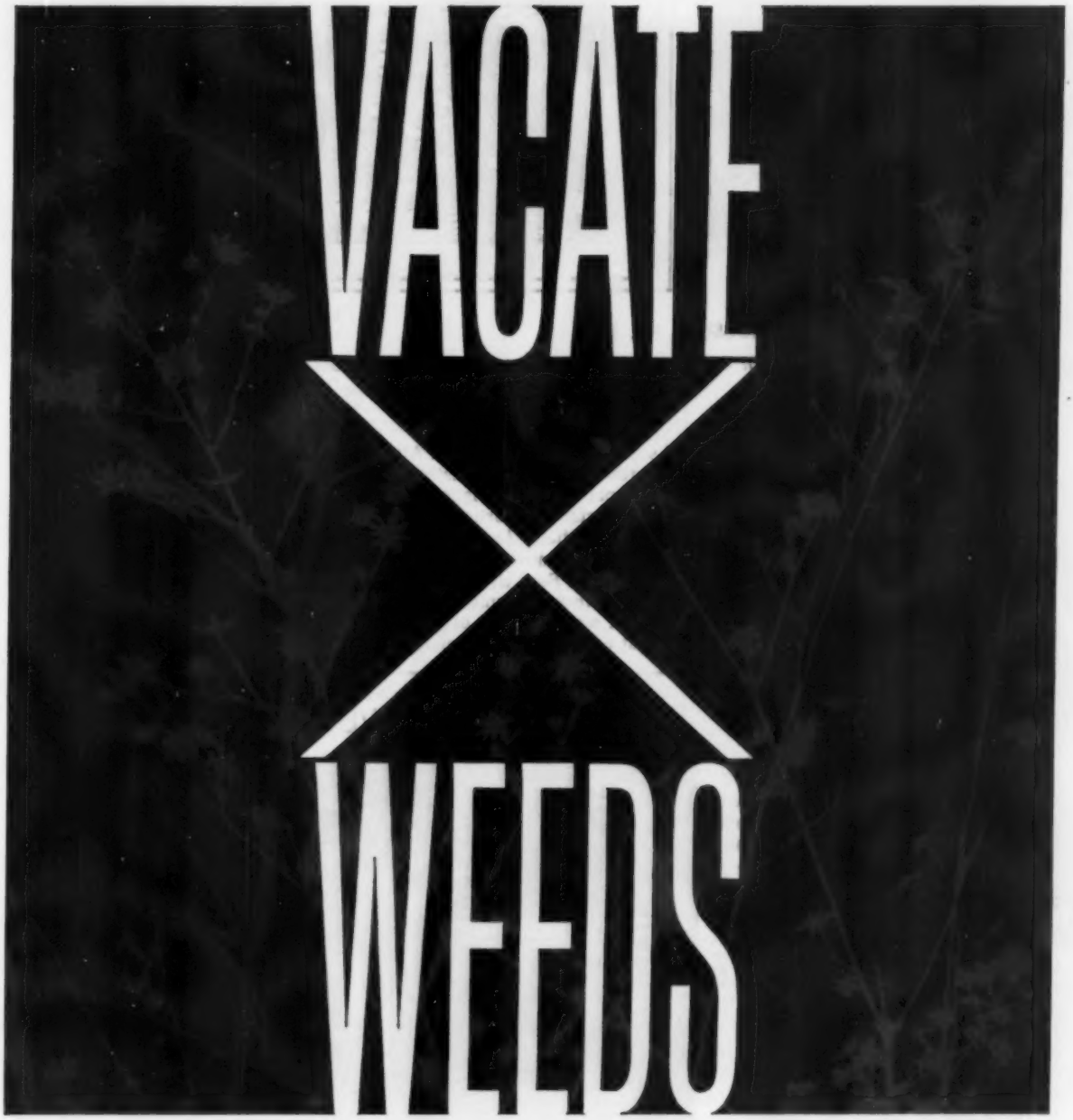
- Wausau Snow Plows - Vee and Blade
- Wausau Snow Wings
- Wausau Underbody Truck-grader Ice Blade
- Wausau Sno-Thro Loader and Thrower
- Wausau Material Spreaders
- Write for full details on all Wausau Products . . . Literature available on every item.



The WAUSAU EXPRESSWAY snow plow is a high speed power reversible blade plow designed for today's modern expressways, toll road and airports. It is the most modern and radical design change in the snow plow industry.

WAUSAU IRON WORKS WAUSAU, WISCONSIN

Pioneer Snow Plow Builders



This new, fast way with VACATE... Diamond's new nonselective herbicide for dry application

This is it. The herbicide you hoped would come. The weed and grass killer that lasts more than one year. A patented feature of this killer is the chemically combined water which makes it dust free. It can be applied *any time* (most economical results are from spring or late fall spreading). It is easy to handle—requires no mixing, hauling water, or using expensive equipment.

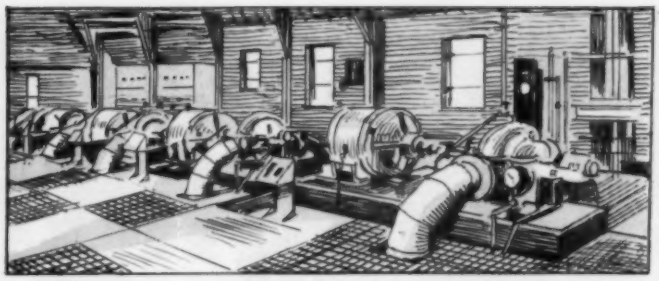
This is Diamond's new VACATE, and it has many physical advantages over previous formulations for battling weeds and grass. VACATE offers economy of application and efficiency in performance.

VACATE can be used anywhere a weed- and grass-free area is desirable. It controls all vegetation. Normal rainfall starts action—a total accumulated rainfall of an inch is ample. And it is safe . . . noncorrosive, nonflammable, and nontoxic. You ought to know the whole story. Write Diamond Alkali Company, 300 Union Commerce Building, Cleveland 14, Ohio.

VACATE is one of the

Diamond Chemicals

THE
WATER WORKS DIGEST



Prepared by **ALVIN R. JACOBSON, Ph. D.**

Associate Professor and Head, Division of Sanitary Science, Columbia University School of Public Health

Limits of Applicability

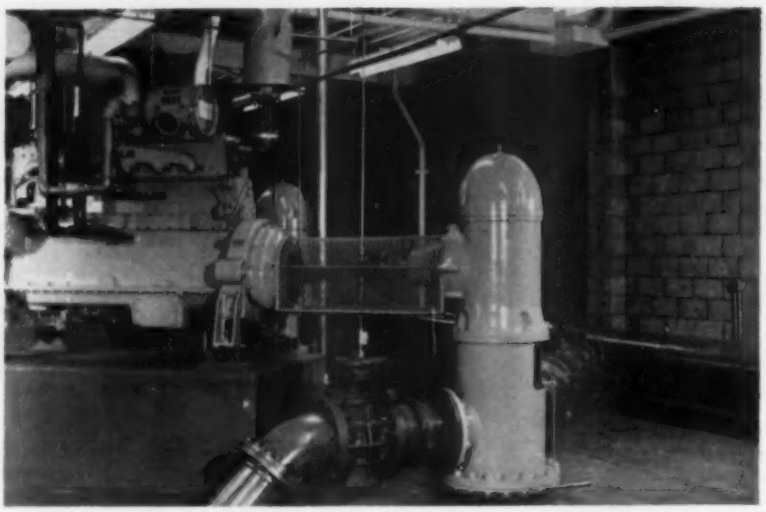
The wide use made of the Hazen-Williams formula in pipe flow computations; and the availability of tables, monograms and slide rules based on this formula, led quite often to its use in cases which are outside its limits of application. Having been struck by the frequent error of going beyond the limits of application of the formula, the author set himself the task of determining these limits under a form corresponding with the Darcy-Weisbach equation and then superimposing the thus transformed equation on Moody's chart. In this manner he finds maximum and minimum values of the coefficient of frictional resistance suitable for use with the Hazen-Williams formula and indicates the Reynolds number ranges outside which the formula cannot be expected to supply any reliable results. The Hazen-Williams formula is applicable only to pipes having a coefficient C in the range 100-106. For each of these pipes the formula should be used only in the range of Reynolds numbers given in the Table of Limits of Applicability supplied in this article.

By M. H. Diskin, Acting Head of Hydraulic Laboratory, Techion-Israel Institute of Technology, Haifa. *La Houille Blanche*, November, 1960.

Turbidity Removal

A research program was initiated in 1955 to determine the feasibility of producing a low turbidity water from highly turbid surface waters for the purpose of 1) recharging depleted underground aquifers, 2) domestic use in rural homes and other agricultural operations and 3) use in remote institutions where well supplies are not available. After considerable laboratory investigation and pilot plant studies it is indicated that a substantial portion of the suspended particles in turbid supplies can be removed with coarse grained media. Raw water turbidity ranged between 40 units and 600 units with a mean value of 75. Under most conditions the filter maintained a turbidity removal of well over 50 percent and in some instances was over 90 percent. General conclusions to be drawn regarding turbidity removal are: 1) The filter is rather efficient in removing all suspended solids but is more effective in removing a colloidal suspension than the larger non-colloidal sized particle; 2) the greatest

GAS ENGINES POWER PUMPING PLANT



A NEW PUMPING PLANT, three miles of transmission lines and a 4,000,000 gallon reservoir represent an investment of over $1 million by Diamond Bar Water Company, a privately-owned public utility certified by the California P.U.C. to deliver softened and filtered water to the residents of the completely planned city of Diamond Bar, Calif.

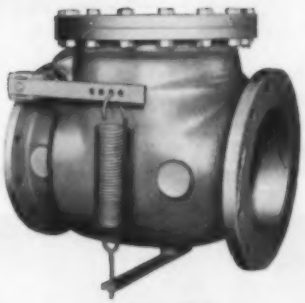
Located in southeast Los Angeles county, Diamond Bar extends over 12.9 square miles of beautiful rolling hill countryside that is expected to be the residence for 75,000 in the next decade. The initial water facility is designed to serve the first 2,000 residents of the community, according to C.J. Peterson, general manager of the water company.

Two 235 hp Caterpillar engines which use natural gas as a fuel have been installed to drive vertical turbine pumps.

EDDY New Improved Products Meet Modern Needs

EDDY Fire Hydrant

- Improved, streamlined, modernized
- Optional break-flange
- Large diameter barrel
- New self-sealing main valve packing
- Requires no lubrication
- Opens *with* pressure
- Closes *against* pressure
- Underwriters' listed
- Standardized, interchangeable parts

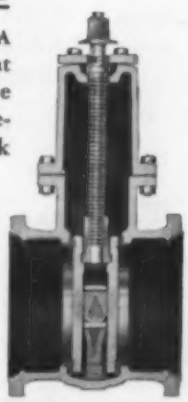


EDDY Check Valves

Completely new designs of horizontal swing check valves are available in sizes from 4 through 12 inches. They operate dependably in either vertical or horizontal positions and incorporate construction features which provide unusual flexibility of operation. These valves may be converted in the field from plain to single- or double-lever operation to meet changing requirements. Other check valves up to 24 inches.

EDDY Gate Valves

In addition to the regular line of EDDY Taper Seat AWWA gate valves, EDDY now offers a newly designed parallel seat AWWA gate valve in sizes through 12 inches. This valve has been specifically engineered to provide long, trouble-free service. Working parts are designed with heavy, thick section and large seating surfaces for dependable operation and improved wearing qualities. The valve has two-point, free-floating wedging for minimum friction and maximum operating ease. Other AWWA gate valves are available through 48 inches.



Whatever your waterworks requirements, it will pay you to have full information on the complete EDDY *line of valves and hydrants.*

EDDY VALVE COMPANY
A Subsidiary of James B. Clow & Sons, Inc.
WATERFORD NEW YORK

weakness was observed in the removal of live algae; 3) the aging of the filter by use causes a marked improvement in filtration action; 4) the efficiency of turbidity removal is inversely proportional to the raw water turbidity; and 5) seasonal variations are minor except for the indirect effect of high raw water turbidity following intense summer rainstorms. A 500-gpm field installation is now under construction, the effluent of which is to be used for ground water recharge experimentation.

"Turbidity Removal with Coarse Grained Filters." Loren E. Heiple, Head, Civil Engineering Department, University of Arkansas. PUBLIC WORKS, April, 1961.

Improvements at Hopewell

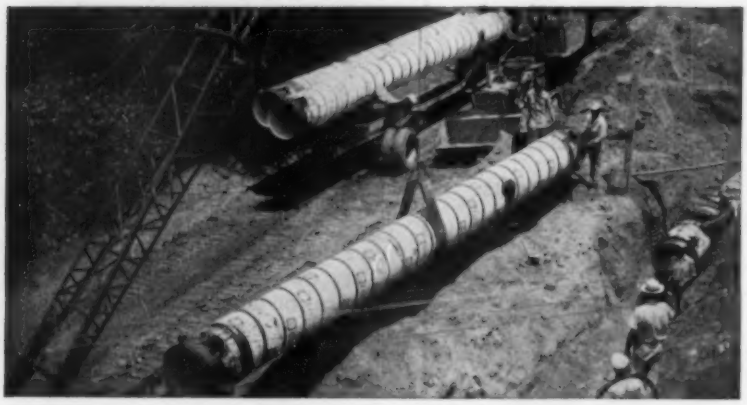
A 6-year improvement program, involving numerous studies, tests, and plant changes and additions, has led to an improved water quality at the Old Dominion Water Corporation supplying the City of Hopewell, Va. The water company is unique in that 88.5% of the 25 mgd treated is distributed to several large industrial chemical concerns and the remainder to the 5,000 residential consumers. The raw water is obtained from the Appomatox River and is pumped through two 36-in. lines to the treatment plant consisting of a circular steel flocculation basin (capacity 127,000 gal.), five settling basins (two concrete rectangular and three steel circular, with capacity of 5.25 mil. gal.), 50 wooden tub filters with a nominal rated capacity of 32.25 mgd, and three clear wells with a capacity of 3.10 mil gal. Present treatment consists of: 1) Free residual chlorination; 2) lime addition where needed; 3) application of alum and activated silica; 4) pH correction with lime just ahead of the filters; 5) postchlorination or dechlorination with sulfur dioxide gas as needed, and 6) final pH correction with hydrated lime if needed. The author discusses the various physical changes that have been made in the Old Dominion Water Corporation treatment plant, but of equal or greater importance has been the development of laboratory control methods that have brought about an improved quality that meet the high standard of the industrial chemical concerns.

"Quality Improvements Resulting From Industrial Needs at Hopewell." By Elmer F. Eld, Mgr., Old Dominion Water Corp., Hopewell, Va., and Martin E. Flentje, Chief San. Engr., American Water Works Service Co., Philadelphia, Pa. *Journal AWWA.*, March, 1961.

Rochester's Water Works Program

The City of Rochester, Michigan, a suburb of Detroit, has recently completed a $311,000 water works modernization program to meet the increasing needs of this industrial community of 5,400 persons. The major contracts included the construction of a new 750,000-gallon elevated water storage tank; installation of cast iron water mains to transmit the flows from the well field to the village and to the elevated storage tank; development of a pump motor control system to provide for automatic remote control of well pumping units; installation of new pumping units and accessories at wells; and installation of electrical work necessary to complete the pumping system. Aesthetics were given consideration in the selection of the tank design and painting scheme, the final selection being a spheroidal bottom tank painted with a light green aluminized paint. The project was financed through sale of $280,000 revenue bonds. For fire protection afforded

ATLANTA *chose* STEEL PIPE



. . . every length was hydrostatically tested in the shop to AWWA standards!

To provide for industrial and residential expansion in South Fulton County, Atlanta Water Works installed an additional 8,200 ft. of steel pipe along Fairburn Road. This new line incudes 2,916 ft. of 36 in. pipe and 6,200 ft. of 30 in. pipe, all with 5/16 in. wall thickness and in 50 ft. lengths.

STRENGTH
TIGHTNESS
ELASTICITY
ECONOMY
LONG LIFE

. . . these are inherent qualities of fabricated *steel* pipe. Compare *steel* pipe with other types . . . you'll see why "wherever water flows, steel pipes it best." You can always specify *steel* pipe with confidence.

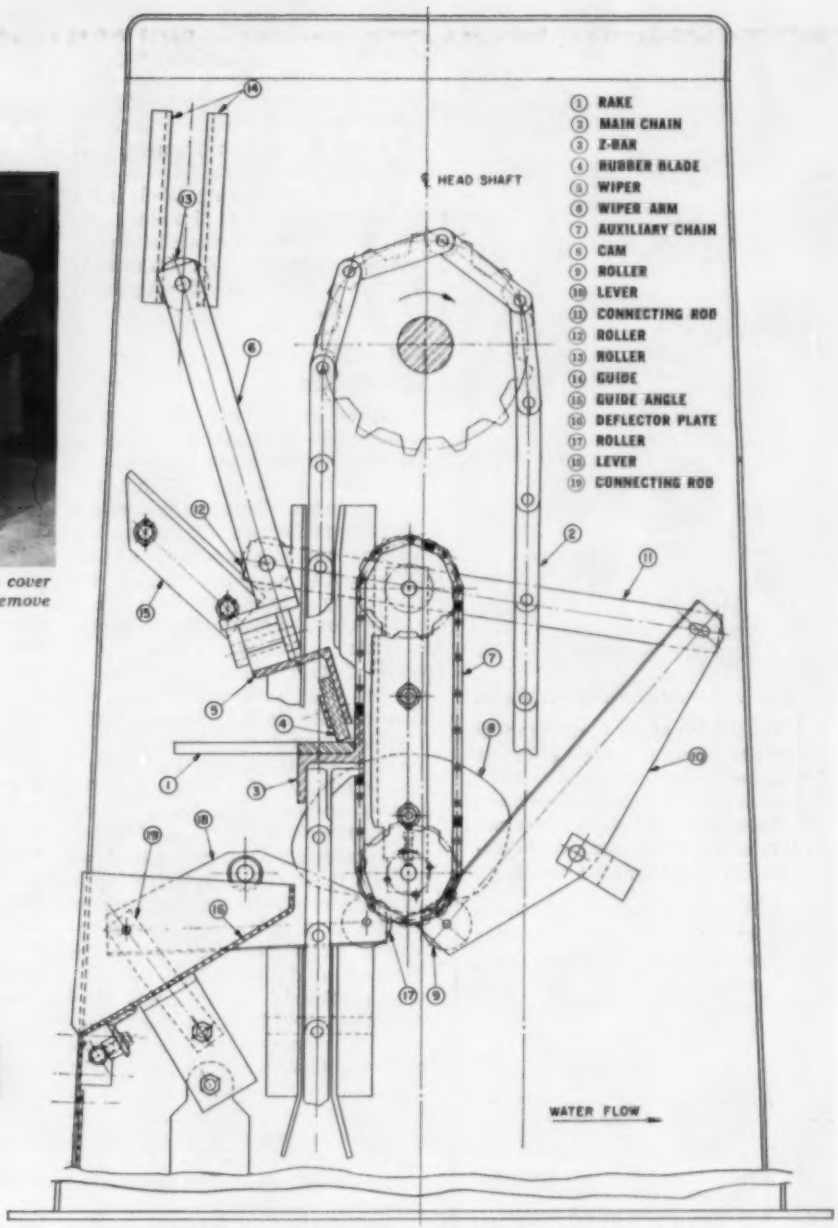
For your copy of the latest steel pipe brochure, write—

STEEL PLATE FABRICATORS ASSOCIATION
105 West Madison Street • Chicago 2, Illinois

STEEL PLATE FABRICATORS ASSOCIATION

Vertical back-cleaned bar screen with cover removed to show traveling rakes that remove waste from screen.

Modern Jeffrey screens assure successful operation



RAKE WIPER MECHANISM FOR VERTICAL BAR SCREEN (Pat. Applied For)

The latest Jeffrey designed screens incorporate the most advanced operating techniques in back-cleaned screens. The design has been constantly improved from year to year since Jeffrey built the first practical back-cleaned screen.

The head frame has been streamlined to present an attractive housing which contains the new Jeffrey cam operated wiper and tilting tray mechanism. Moving rakes engage lugs on auxiliary chains which control the action of the cam.

The wiper is free to move on each end to insure uniform bearing of the wiper blade on the rake even when the rake is out of alignment. The entire mechanism is positive and silent.

The head frame is shipped completely assembled as shown, after it is factory tested. The boot section is also factory tested and assembled before shipment to customer.

Jeffrey Sanitary Engineers offer help in adapting these screens and other Jeffrey products to water, sewage and waste recovery plants. For a copy of Bulletin 952 describing these services, write The Jeffrey Manufacturing Company, 947 North Fourth Street, Columbus 16, Ohio.

If it's conveyed, processed, or mined, it's a job for Jeffrey.

JEFFREY

ALL NEW!
FULLY
TRANSISTORIZED
Detectron
PIPE DETECTOR

In addition to the famous model "505" Detectron now offers its completely new model "808" with the first circuitry developed specifically for use with transistors. It is NOT merely an adaptation of earlier tube circuits.

Efficient under every known operating condition, effective in varying temperatures, thoroughly proven and trustworthy. Superior performance and reliability guaranteed.

EXCLUSIVE FEATURES

- Detects Deeper by all comparisons
- Automatic Switching for direct connection
- High Energy-Transfer-Ratio
- Printed Circuits, properly shielded
- Separate Oscillator System
- Highly Perfected Loop Antennas
- Economical Standard Long-Life Batteries
- Built-In Battery Testers
- Snap-Lok Connecting Handle
- Aluminum Cases for maximum protection

Written Lifetime Guarantee on CMC parts and workmanship

For specifications and prices, write for File No. Dept. 147

COMPUTER-MEASUREMENTS CO.
Utilities Instruments Div.
12970 BRADLEY, SYLMAR, CALIF.

by the 750,000-gallon elevated water storage tank, Parke, Davis & Company provided the property for the tank site and made a cash contribution in the amount of $31,000, making the total funds available for the water works improvement program $311,000.

"From Free-Flowing Wells to a Full-Grown Water System." By Raymond J. Smit, Associate, Ayres, Lewis, Norris & May, Consulting Engineers. *Water Works Engineering*, March, 1961.

National Water Plan

The Office of Civil and Defense Mobilization has issued national plans for "Management of Resources After Attack on the Continental United States." This annex outlines the responsibilities for providing, treating, and safeguarding water for all essential purposes during the emergency, together with procedures for the emergency operation of water resources facilities. It is assumed that under conditions of general war, with attack upon the Continental United States, water supplies would be destroyed, adversely affecting both the quality and quantity of the water. The general responsibilities of the various agencies of the federal, state and local governments are outlined, as well as those of the industries, private organizations and each person or family in order to meet the essential water needs necessary for national and individual survival. Organizational arrangements and procedures within the regular operating program of each agency concerned with water supply and water resource management should be established to provide water supplies under emergency conditions. Mutual aid activities should be provided for exchange or assignment of personnel, machinery and stocks of essential materials and equipment on a current basis, among water supply utilities during emergencies. Personnel training programs should be provided to improve the competence of personnel who are concerned with public water supplies. Provisions should be made for providing the public with essential information and the responsibilities of each of the federal, state and local governmental agencies during an emergency. Emergency operating plans should be developed to put this annex into effect at all levels upon a declaration of a civil-defense emergency or in event of an attack.

"National Water Plan." Issued in April, 1960 by the Office of Civil and Defense Mobilization. *Journal AWWA.*, March, 1961.

Water Supply in Peru

The author spent 5 weeks in Peru in 1960 as a short-term consultant to the International Cooperation Administration (ICA), as part of the Community Water Supply Development Program of ICA. Under this program and in collaboration with WHO and PAHO, ICA is assisting cooperating countries to develop or strengthen business-type, self-sustaining national institutions that will plan and aid financing, construction, and management of water supply systems at the community level. The author's specific assignment was to serve as a consultant on rates and financing of a 7,000,000 expansion of the water and sewerage facilities of Arequipa, Peru, a city of about 90,000 residents supplied through approximately 11,000 service connections. In the $7,000,000 project are included extensive improvements to the distribution system, a number of new ground storage reservoirs, extensions to serve the new suburban areas, and water meters for all existing and future services. Also included in the project is a complete treatment plant for a major portion of Arequipa's waste water, the effluent to be used to reclaim additional land by irrigation. All engineering, including plans and specifications has already been completed by the national Public Works Ministry. The water and sewerage utility for Arequipa will be operated by an "autonomous enterprise," corresponding to the authority form of management in the United States. The new authority will be a financial entity and will have power to set rates, enforce collection, and establish service rules. The Arequipa project serves as an excellent illustration of the type of aid ICA and PAHO are striving for—to help the developing countries help themselves, through the vehicle of the Community Water Supply Development Program.

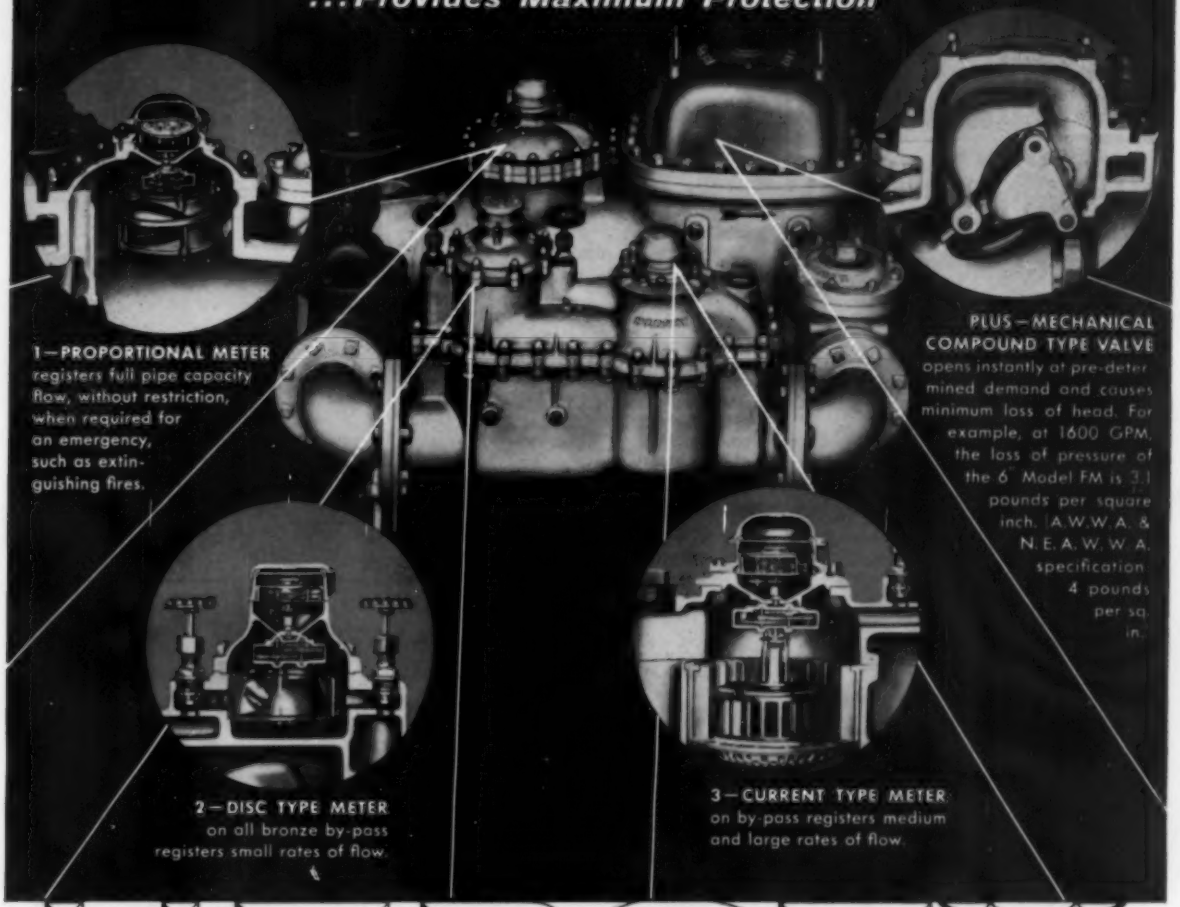
"Water Supply Administration in Peru." By Harris F. Seidel, Director, Water & Sewage Treatment, Ames, Iowa. *Journal AWWA*, March, 1961.

Other Articles

"Public Versus Private Operation." A private water company official explores the problems of administration, financing, labor relations, accounting

3-in-1 FIRE SERVICE METER PRODUCES MAXIMUM REVENUE

...Provides Maximum Protection



1—PROPORTIONAL METER registers full pipe capacity flow, without restriction, when required for an emergency, such as extinguishing fires.

PLUS—MECHANICAL COMPOUND TYPE VALVE opens instantly at pre-determined demand and causes minimum loss of head. For example, at 1600 GPM, the loss of pressure of the 6" Model FM is 3.1 pounds per square inch. A.W.W.A. & N.E.A.W.W.A. specification 4 pounds per sq. in.

2—DISC TYPE METER on all bronze by-pass registers small rates of flow.

3—CURRENT TYPE METER on by-pass registers medium and large rates of flow.

HERSEY

Detector (FIRE SERVICE) Meter – Model FM-CT

Sizes 6", 8" and 10" of Model FM-CT with Compound by-pass and sizes 3" through 10" with Disc by-pass are listed as standard under the Re-examination Service of Underwriters' Laboratories, Inc., and approved by Factory Mutual Laboratories for use in Factory Mutual insured properties, also listed by Underwriters' Laboratories of Canada.

VISIT OUR EXHIBIT AT THE AWWA CONFERENCE JUNE 4-9, COBO HALL, DETROIT, MICH. YOU'LL FIND US IN BOOTH Nos. 106, 108, 110, 112.

Hersey-Sparling
Meter Company
HERSEY PRODUCTS
DEDHAM, MASSACHUSETTS

Branches: Atlanta, Boston, Chicago, Cleveland, Dallas, Denver, Kansas City, Mo., Los Angeles, New York, Philadelphia, Portland, Ore., San Francisco, Seattle.

To specify
MODERN WATERPROOFING METHODS

Consult a Western Waterproofing Engineer

The most modern techniques of stopping water damage are used daily by Western Waterproofing. Western relies on tried-and-proved methods and sound engineering principles – not patented materials alone – to solve waterproofing problems. All work done under contract, fully insured and guaranteed.

Consult Western about specifications for preventive maintenance and building restoration, about special methods and materials, including...

- **RESTOCRETE METHOD** of protecting architectural concrete.
- **DILATO METHOD** of sealing exterior masonry motar joints.
- **IRONITE METHOD** of withstanding subsurface hydrostatic pressures.
- **PARGE COAT METHOD** for above-grade water protection and plaster bond.
- **WET AGGREGATE METHOD** for cleaning limestone.

TUCKPOINTING • BUILDING CLEANING
CONCRETE RESTORATION
SUB-SURFACE WATER PROTECTION
(No materials for sale)

Write today for FREE BOOKLETS
prepared for Architects, Engineers, Contractors, Building Owners, and Administrators.

☐ **WALLS BREATHE?**—A comprehensive review of modern methods of protecting masonry walls from water penetration and disintegration.

☐ **WATER DAMAGE CONTROL**—A professional treatise on a vital subject.

☐ **EFFLORESCENCE** – A technical reprint, ASTM Bulletin, No. 185.

WESTERN WATERPROOFING CO.
A Missouri Corporation And Its Affiliate
RESTORATION COMPANY
1223 Syndicate Trust Bldg. • St. Louis 1, Mo.
NATIONWIDE SERVICE

and purchasing. By Leo Louis, President and General Manager, Gary-Hobart Water Corp. Water Works Engineering, March, 1961.

"**$20,000 Water Bills** a Month." Data processing system speeds up Newark, N. J., business office and customer service operations. Water Works Engineering, March, 1961.

"Trends in Water Supply **Legislation and Litigation.**" This paper originated as part of a report presented to the annual convention of the National Institute of Municipal Law Officers, Pittsburgh, Pa., by the author as Chairman of the Committee on Municipal Water Problems. By Edward F. Taylor, Taylor & Smith, Attorneys, and City Attorney, Redlands, Calif. Journal AWWA., March, 1961.

"Solubility of **Radioactive Bomb Debris.**" Radioactive debris resulting from a normal nuclear detonation is only sparingly soluble in water in the normal pH range of natural surface waters. By Don C. Lindsten, Chief, Research Sec.; Paul B. Pruett, Project Engr.; and Richard B. Schmitt, Branch, Chief, all of San. Sci. Branch, U. S. Army Engineer Research & Development Laboratories, Fort Belvoir, Va., and William J. Lacy, Chief Radiochemist, Physical Sciences Div., Research Office of Civil & Defense Mobilization, Battle Creek, Mich. Journal AWWA., March, 1961.

"35 Million Worth of **Water System Deadlines**—and More to Come." Meeting the water needs of the mushrooming metropolis of Phoenix, Arizona. By Art. F. Vondrick, Assistant Water and Sewers Director, City of Phoenix, Arizona. Public Works, April, 1961.

• • •

Utility Truck for Sewer Maintenance

The Sanitary Board of Weirton, W. Va., has placed in service a new truck with a utility body designed to carry in convenient file-box arrangement all the varied and unusual equipment used in cleaning and repairing sewerage systems. The body, manufactured by the Reading Body Works, serves both as a means of transporting equipment to the job and as a mobile workshop for the sewer maintenance crew.

Designed with weathertight outside compartments of varying size, with interior space for larger equipment, the body carries snakes, rods, augers and related tools, and a 3-inch diaphragm type pump—with a place for everything in its place. All compartments have removable shelves and adjustable shelf dividers for flexibility of arrangement. A red blinker light is installed on the top of the closed type body; there are clamps for carrying a collapsible aluminum ladder.

VISI-METER TURNS YOUR METER READING INSIDE-OUT!

Remote registry for WATER or GAS METERS
A practical remote indicator and recording system. Tested and approved. Now used by 90 cities. ViSi-Meter eliminates city expense and liability of controlling keys to customers' residences. Easily read in one trip by meter readers.

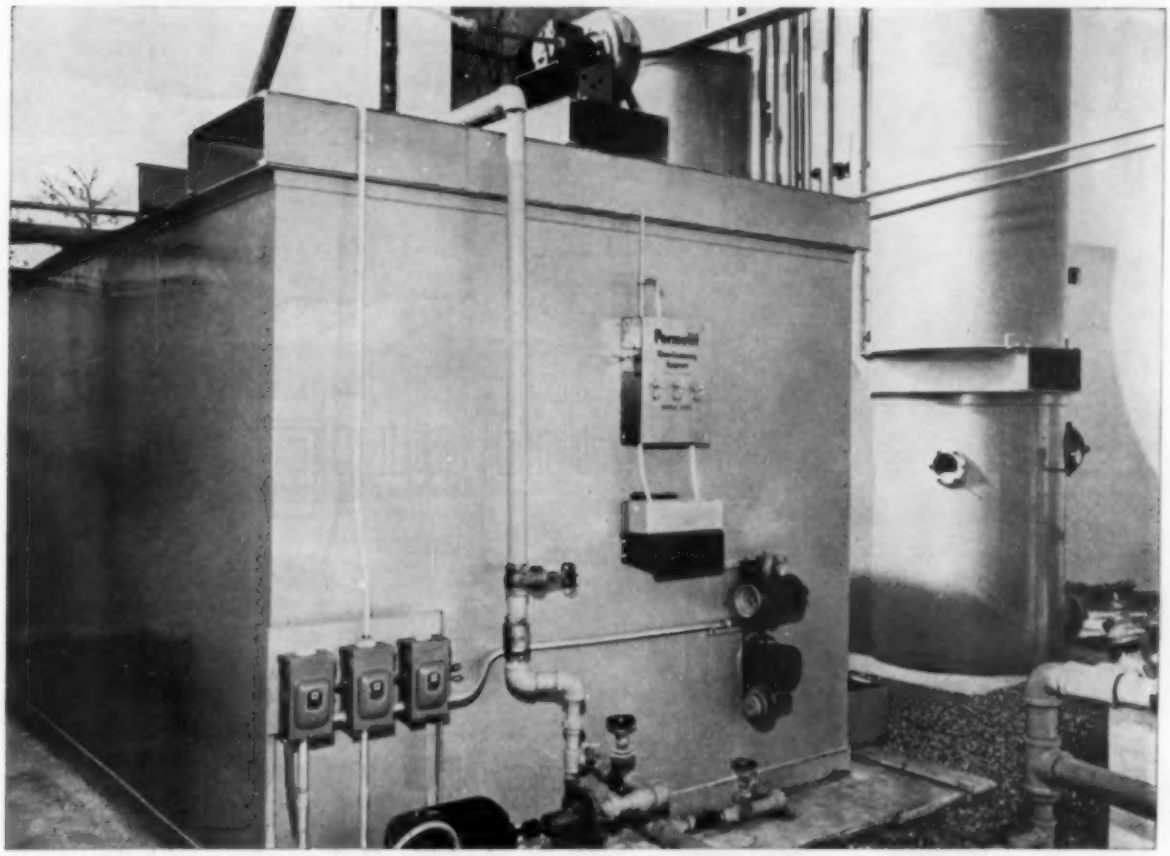
- Accurate within .01%
- Requires minimum up-keep
- Protected with Tamper proof seals

This Product Is Manufactured and Guaranteed by
VISI-METER, INC.
301 NORTH 17th STREET, KANSAS CITY, KANSAS

NEW CATALOG!

WRITE TODAY
For
100 PAGE
MUNICIPAL CATALOG
W. S. DARLEY & CO.
CHICAGO 12

FLUIDICS* AT WORK



This Permutit packaged automatic plant treats water for Bahia Vista Estates, de luxe trailer community, in Sarasota, Florida. System contains degasifier, Precipitator, chemical feeders, two Automatic Valveless Filters.

New way to save money when you treat water for smaller communities

You're looking at a new idea in water treatment: a *packaged, automatic* plant, custom engineered by Permutit to save you construction, installation and operating dollars.

Such systems are now available for smaller communities using from 10 to 100 gpm. . . and at economical cost.

This is possible because of the range of sizes in which we offer standard, package equipment for each step in water treatment, including: removal of carbon dioxide, oxidation of ferrous iron or hydrogen sulfide, softening, removal of turbidity, chlorination, and filtration.

Fully automatic, low-cost operation. Your Permutit plant operates automatically, practically runs itself day in and day out, keeping your labor and operating costs at a minimum. Even the filters automatically backwash themselves at the right time, rinse themselves, and go back into operation—without so much as a glance from an operator! The unique Permutit® Automatic Valveless Gravity Filter makes this possible.

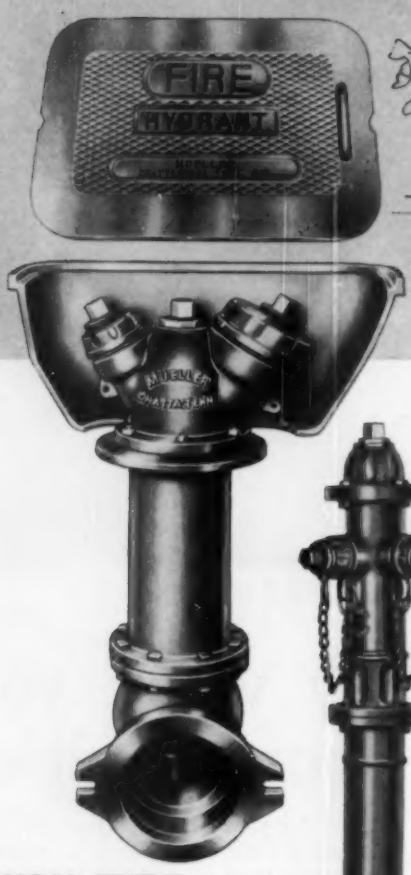
Send for prices, details. At no obligation to you, we'll gladly give full details on how a Permutit packaged plant can be tailored to your local conditions. Write to: Permutit Division, Pfaudler Permutit Inc., Dept. PW-51, 50 West 44th Street, New York 36, N. Y.

PFAUDLER PERMUTIT INC.

Specialists in FLUIDICS...the science of fluid processes

*FLUIDICS is the Pfaudler Permutit program that integrates knowledge, equipment and experience in solving problems involving fluids.

for that specialized application...



FLUSH TYPE

For use at airports, on narrow streets or sidewalks and in other areas where post type hydrants are impractical.

AWWA 4¼" or 5¼" valve opening two-way or three-way

2½" valve opening . . .one-way

MUELLER®
Fire Hydrants

Built with the same care and quality as the Mueller AWWA Standard Fire Hydrants for municipal use, these Mueller Fire Hydrants for special applications have exactly the same design features, too:

- Compression-type main valve that provides positive closures is always ready for use.
- Automatic drain valve that is flushed clean with every operation, empties barrel completely to prevent freezing.
- O-ring that assures positive, leak-proof seal requires no maintenance.

Standardize on the quality and features of Mueller fire hydrants for municipal, industrial, commercial and private fire protection systems.

POST TYPE

for use on private estates, at country clubs, in parks, for dead-end flushing and wherever smaller amounts of water are sufficient.

2½" valve opening
. . . one-way or two-way

Write for complete information and specifications.

MUELLER CO.
DECATUR, ILL.

Factories at: Decatur, Chattanooga, Los Angeles
In Canada: Mueller, Limited, Sarnia, Ontario

5892

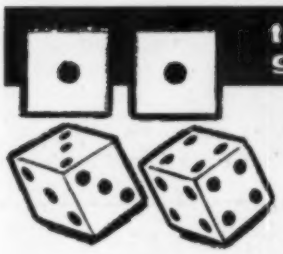
Custom-Engineered Luminaires for Municipal Garage

ENGINEERING studies concerning the lighting of New York City's first municipal garage at the Brooklyn Civic Center indicated that fluorescent lighting tubes should be enclosed to prevent pilferage, guard against breakage by automobile aerials, and prevent dust from collecting on the tubes. Accordingly, a special fixture and lens combination was jointly engineered by the McPhilben Manufacturing Co., Inc., Brooklyn, N. Y and the Holophane Co., New York, N. Y. The longitudinal fixtures (McPhilben) are designed for 4' long tubes and come in 4 and 8' lengths. The lenses (Holophane) were designed in 2' lengths to fit the modular pattern and to enable economic production with standard molding facilities. The lenses not only satisfy the objectives established by the engineering studies, but also improve light output.

Four different illumination levels are used: A high level area, 55 f.c., at the garage entrance; a transition area of about 30 f.c. between entrance and main parking area; aisle areas with 5 f.c.; and 3 f.c. in the parking areas.

The new garage, which is New York's first municipal garage, opened the forepart of 1960. It has a capacity of 750 cars, extends three stories below grade, has a city park on the roof and services a complex of multistory municipal buildings in downtown Brooklyn. Nearly 84 000 cars used the facility, during the first five months of operation. Average parking time is about 4 hours, according to the Traffic Department.

Consulting engineers were Rouse, Dubin & Ventura, New York. Project builder was the Department of Public Works.



this is a gamble...

McGOWAN PUMPS are a sure thing!

It's tough enough to gamble on the weather when you are pressed for time on the job . . . but don't gamble on performance, buy the dependable McGowan Pump. Easy to operate, with lower operation costs plus the finest engineering features.

McGOWAN PUMPS

DIVISION OF LEYMAN MANUFACTURING CORP.

10946 Kenwood Road
Cincinnati 42, Ohio

WATER MEASUREMENT

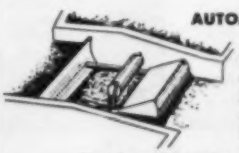
. . . accurate easy to read

PARSHALL MEASURING FLUMES

Easy to read, accurate water flow indicator. Not affected by silt deposits or stream velocity. Easy to install. Heavy gage steel; will not warp, swell or crack.

- Self-cleaning
- Easy to read
- Low head loss
- Throat widths: 3" to 10'

WATER WELL SCREEN FOR EVERY SOIL CONDITION. Choice of perforations and 4 field joints. Stainless, and galvanized steel. From 6" to 36" diameters.



AUTOMATIC WATER CONTROL GATES

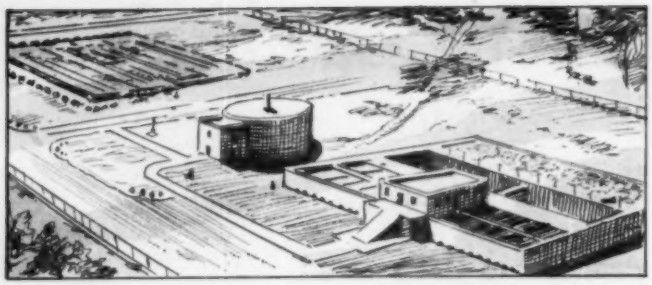
Accurately control water level upstream or downstream, in canals, ditches and reservoirs, regardless of flow. Eliminates washouts, flood damage and labor costs, (no gate keeper necessary).

Used world wide. Write for FREE literature. TPD-18

THOMPSON PIPE & STEEL COMPANY

3025 Larimer Street Denver 1, Colorado TAbor 5-1241

THE
SEWERAGE
AND
REFUSE
DIGEST



Prepared by **ALVIN R. JACOBSON, Ph.D.**

Associate Professor and Head, Division of Sanitary Science, Columbia University School of Public Health

Nitrates in BOD Dilution Water

Investigations were designed to determine the feasibility of substituting nitrate for ammonia in BOD dilution water as recommended in Standard Methods for long term BOD studies on sewage, industrial wastes and other groups of organic substrates. On the basis of the data obtained it was concluded that: 1) Nitrates constitute a satisfactory source of nitrogen, except that it may not be as readily available as ammonia in the early oxidation phase of certain organic substrates. The resultant lag in oxidation with nitrate dilution water may yield lower 5-day or even 10-day BOD values than those with ammonia dilution water. 2) The advantages of using nitrate in BOD dilution water are three-fold with respect to long-term BOD studies: (a) In BOD tests on sewage using ammonia the 20-day BOD values increased from 278 to 590 ppm as the sewage volume per bottle decreased from 6.0 to 2.0 ml. Substitution of nitrate dilution water minimized these BOD variations and yielded an overall average in substantial agreement with the highest sewage concentration in ammonia dilution water. (b) Tests on pure organic substrates require artificial seeding and it is necessary to include seeded blanks. With nitrate dilution water there is only slight nitrification in the blanks, therefore, correction for seed results are unnecessary as these corrections would decrease the BOD values. (c) In tests using nitrate dilution water, once carbonaceous oxidation is complete, oxygen-uptake ceases and the long term (20-day) BOD value better represents the ultimate carbonaceous BOD of any particular carbonaceous substrate.

"Nitrate as the Nitrogen Source in BOD Dilution Water." By Peter E. Gaffney and Robert S. Ingols, Assistant Professor of Applied Biology and Professor of Applied Biology, respectively, Georgia Institute of Technology, Atlanta, Ga. *Water & Sewage Works*, March, 1961.

Sewage Works Management

Within recent years the operation and maintenance of sewage treatment plants, particularly those in large cities, has become big business. In many instances the cost of operation exceeds $1,000,000 per year. The operator should be interested in obtaining the greatest efficiency that is possible from the funds spent for operation and maintenance of facilities. His aim should also be to produce an effluent that will not be detrimental to the watercourse into which it discharges. The author states that the operator should have the following managerial qualities: 1) He should know the operating characteristics of plant units and equipment under all possible conditions. 2) He should know the actual limits of his authority over personnel and in purchasing of materials. 3) He should allow his employees to be part of a team and give them a morale-building classification and compensation plan. 4) He should have a public information and relations program. 5) He and his staff should keep up to date with developments and take advantage of research opportunities. 6) He should provide complete monthly and annual reports for his superiors and for the public health authorities. 7) He should practice that dominant principle of executive control, supervision by leadership. Since the sewage works manager's position is one

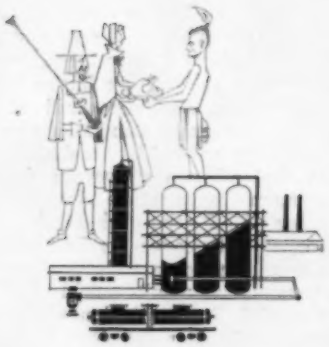
Big Pipe Sections for Outfall Line

SECTIONS of concrete pipe for New York City's Newtown Creek Pollution Control Project are shown being convoyed across Goethals Bridge from Lock Joint Pipe Company's plant in Kenilworth, N. J., to Staten Island. The 64-ton sections of sewer outfall piping, each section 10 feet long and 14 feet in diameter, are too large for Holland or Lincoln tunnels or for Manhattan streets. They will be taken by barge from Staten Island to their final site in the East River.

Historyland...

fine Hopewell, Virginia tradition
with modern P.F.T. equipment

Pilgrims, Progress and P.F.T. mold the colorful history of Hopewell, Virginia.



Hopewell's historic roots go back to 1607, a week before the settlement of Jamestown. Today Hopewell is a modern progressive city of over 20,000 people with a growing chemical industry. Here is truly a wonderful blend of the old and the new.

Steady growth demanded, among other things, that efficient sewage treatment facilities be provided. Sewage treatment equipment by P.F.T. (where quality and engineering know-how has been a tradition since 1893) was specified by the consulting engineering firm of R. Stuart Royer and Associates, Richmond, Virginia.

P.F.T.'s pollution control equipment at Hopewell includes 2 P.F.T. 60′ Floating Covers with P.F.T. Insulated Aluminum Roofing and P.F.T.—Pearth Gas Recirculation. 1 P.F.T. #500 Heater and Heat Exchanger Unit, 2 P.F.T. Liquidometers with High and Low Level Alarms and 1 lot P.F.T. Gas Safety Equipment.

P.F.T. Floating Covers shown in foreground at Hopewell, Virginia

P.F.T. *waste treatment equipment exclusively since 1893*
PACIFIC FLUSH TANK CO.
4241 RAVENSWOOD AVENUE, CHICAGO 13, ILLINOIS

PORT CHESTER, N.Y. • SAN MATEO, CALIF. • CHARLOTTE, N.C. • JACKSONVILLE • DENVER

of vital importance to a community, his selection should be made with great care.

"What You Should Know About Managing Sewage Treatment Works." By C. E. Keefer, Sewerage Engineer, Bureau of Sewers, Baltimore, Md. PUBLIC WORKS, April, 1961.

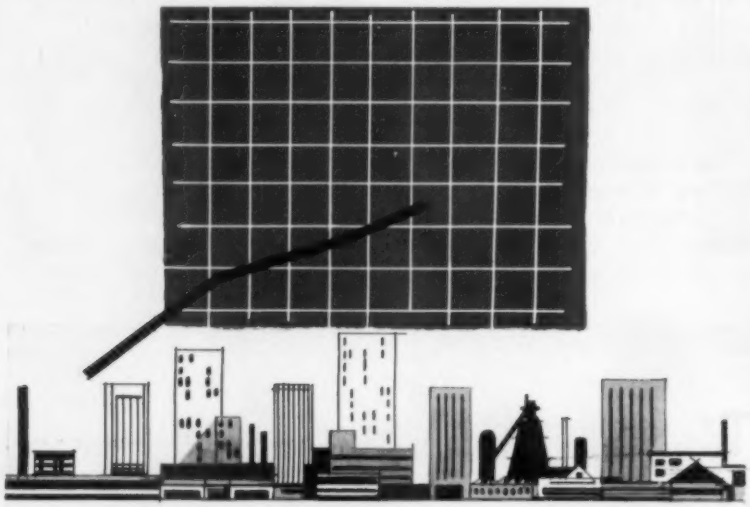
Fly Larvae in Refuse Cans

Fly nuisances in the Concord, Calif., area prompted the residents to form a citizens committee to investigate the various ways of controlling flies. It was apparent that the fly problem was general throughout the area and the citizens petitioned the existing Contra Costa Mosquito Abatement District to provide fly control work on an area-wide basis. A simple method of investigating the problem of larval migration from the garbage can was developed and used throughout the studies. The results show that large numbers of larvae migrated from the refuse cans to pupate before the refuse was collected. An average of 1,128 larvae per can per week were found during the two years of study, which included a total of 583 weekly observations. By collecting two specimens each week from each can, it was found that from 89.4 to 98.6 percent of the larvae left the garbage cans during the last three days of the week. The question of how 1.4 to 10.6 percent of the larvae were able to develop and migrate during the first four days could be answered by the fact that oviposition could have occurred either a) on the first day the refuse was placed in the can; b) before the refuse was placed in the can; or c) the larvae could have been left in the bottom sludge of the garbage can when the refuse was collected. A good correlation was found when the average larvae and pupae counts were compared with the average daily maximum temperature by week. The results indicate that when the average daily maximum temperature by week reaches 75° F., the garbage should be collected twice weekly. This service would increase collection costs but would give results quickly without special effort by the householder.

"The Migration of Fly Larvae from Refuse Containers vs Frequency of Collection." A condensed version of an article written by Ernest Campbell, Manager, Contra Costa Mosquito Abatement District and Ralph J. Black, Senior Vector Control Specialist, California Department of Health. PUBLIC WORKS, April. 1961.

Anaerobic Digestion

The anaerobic digestion process has been used very successfully for the stabilization of sewage sludge. This study was undertaken to determine the fundamental effect of volatile acids on methane formation in anaerobic sludge digestion. This was done by adding high concentrations of the volatile acid salt, sodium acetate, on a slug basis to a series of one-liter laboratory digesters containing an active population of acetate-utilizing methane organisms and observing the effect of this addition on the rate of acetate utilization. For comparative purposes, chloride, sodium bicarbonate, and sodium sulfate were also studied. On the basis of the data obtained it was concluded that: 1) The decreased activity of methane bacteria often observed following a rapid increase in volatile acid concentration and subsequent neutralization is not due to "volatile acid" toxicity, but is associated in a more general way with "salt" toxicity; 2) Salt toxicity is associated for the most part with the type and concentration of the cation



The Future

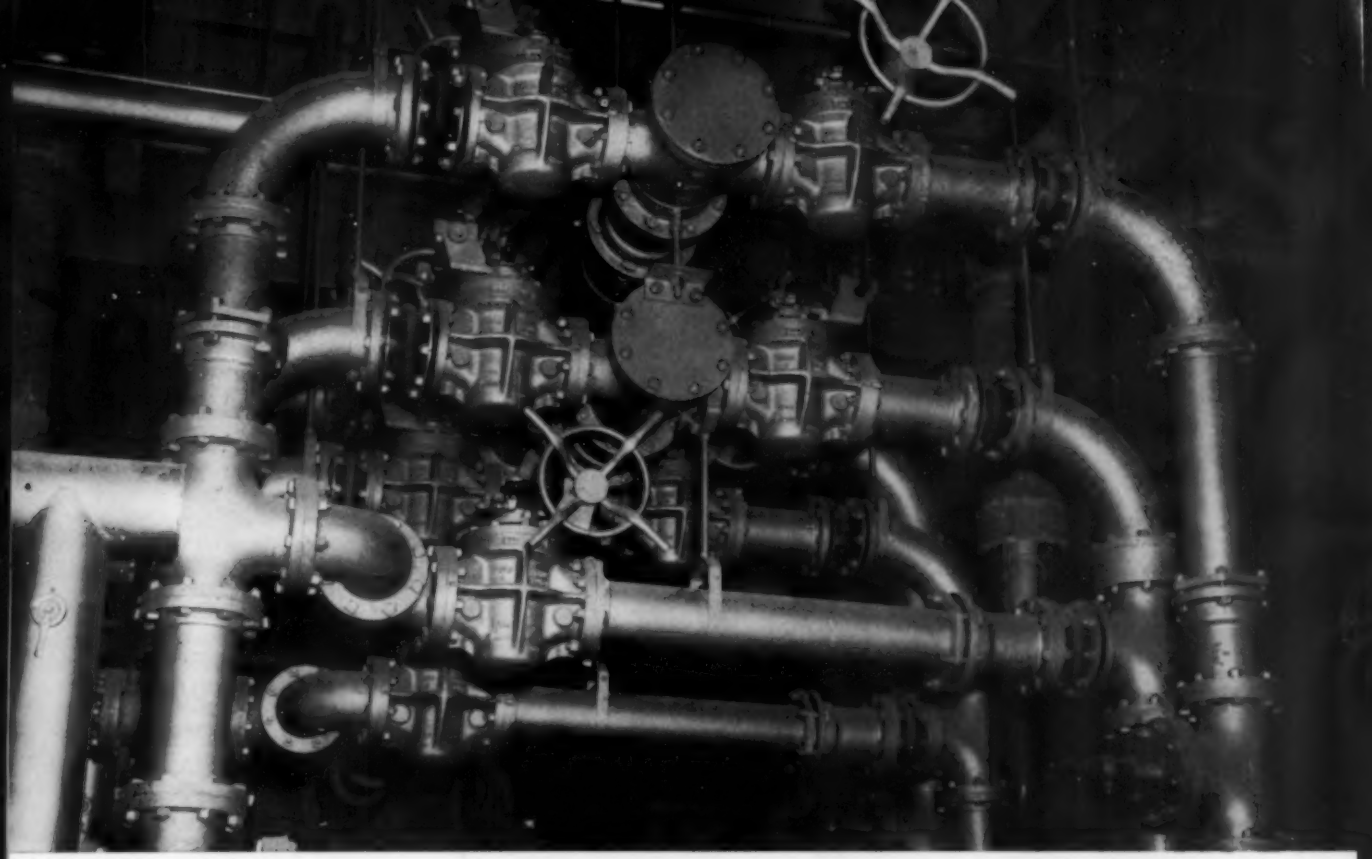
It appears that the demand for M & H valves and hydrants will increase in the "60s", for four reasons: (1) Rapidly increasing population, (2) growing industrial economy, (3) superior quality of M & H products, (4) need of improvements and expansion of water and sewerage facilities.

Although over 17,000 water distribution systems have been built in about 75 years, in over 1,000 of them water consumption has recently been rationed. Engineers estimate that some 60% of all U. S. water supply systems now need major improvements. This situation could easily get worse instead of better due to rapidly increasing population – expected to be 227 million by 1975. A new American is born every 12 seconds or 7,500 new water consumers every day! The U. S. Department of Commerce estimates that in the next 20 years, water supply facilities will need to be doubled, costing approximately $41 billion.

That is going to take valves, hydrants and fittings. We lay no claims to sorcery or clairvoyance. We have no crystal ball, cannot tell the future. But with modesty and humility, we believe engineers will specify that a lot of those valves shall be M & H.

(No. 12 of a Series)

M&H VALVE AND FITTINGS COMPANY
ANNISTON, ALABAMA
SUBSIDIARY OF WALWORTH



CUT YOUR TOTAL VALVE COSTS WITH LUBRICATED PLUG VALVES

For sump discharge, supernatant lines and other wastes services, many large sewage disposal plants have standardized on Rockwell-Nordstrom valves for dependable flow control at lowest overall cost. The simple construction of these rugged *lubricated* valves minimizes maintenance problems—only three basic parts: plug, body and cover. Lubricant also forms a leakproof seal for positive shutoff on heaviest sludge or lightest gas, and vital seating surfaces are always protected from erosive-corrosive line material. You'll get faster, more efficient power operation, too, because these valves are fully closed with just a quarter-turn of the *lubricated* plug—sizes ½" to 36"; pressure ratings to meet your needs. For complete information on Rockwell-Nordstrom's complete line of lubricated plug valves and operating accessories, write Rockwell Manufacturing Company, Pittsburgh 8, Pa. Canadian Valve Licensee: Peacock Brothers Limited.

Lubrication Makes the Difference

ROCKWELL-Nordstrom VALVES

another fine product by

ROCKWELL

Rockwell Manufacturing Company
Department 173E
Pittsburgh 8, Pennsylvania

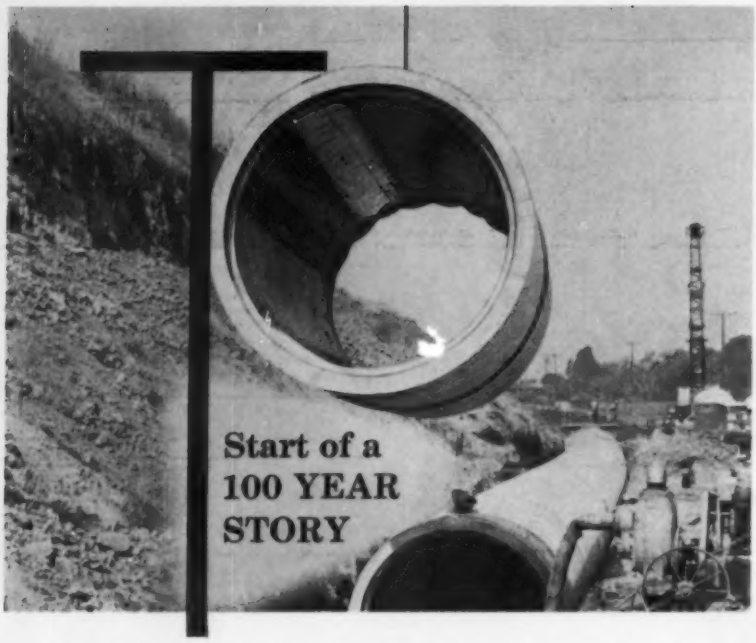
Please send me Bulletin C-5200.

Please have your sales engineer call.

Name_____ Title_____

Address_____

City_____ Zone_____ State_____



This reinforced concrete sewer will be in service generations from now, because concrete surpasses all other materials. Most concrete sewers do not require protection, but when strong chemical effluents or oxidized H_2S are a problem, only T-LOCK AMER-PLATE provides positive protection. T-LOCK AMER-PLATE is a high molecular weight polyvinyl chloride sheet which is cast into the concrete while in the process of manufacture.

T-Lock Amer-Plate meets all the requirements of the ideal sewer lining:

- T-Lock is extremely dense and impervious. Permanently protects concrete from chemical effluents and H_2S corrosion.
- T-Lock is permanently flexible. Tensile strength minimum is 200 psi; elongation at break is a minimum 200%.
- It is mechanically bonded to the pipe. Pull tests result in the breakage of concrete before T-Lock fails.
- T-Lock withstands 40 psi back pressure, equal to a ground water head of 85 feet.
- T-Lock has a smooth, highly abrasion resistant surface... maintains its N factor of .010 indefinitely.

There are no other materials – paints or troweled-on mastics, mortars, sacrificial aggregates or admixes – which meet these vital requirements.

Where protection is required, only T-LOCK will do the job. Compromise methods are a gamble which experienced sewer designers will not take; they know it is money wasted to specify linings which will fail within a few years.

Because T-LOCK AMER-PLATE *is* the only completely satisfactory material on the market today, millions of square feet are now in use in cities throughout the nation.

For a complete list of users and specifiers, plus technical data, write:

Amercoat CORPORATION

Dept. QB, 4809 Firestone Blvd., South Gate, California

921 Pitner Ave. Evanston, Ill. | 360 Carnegie Ave. Kenilworth, N.J. | 111 Colgate Ave. Buffalo, N.Y. | 2404 Dennis St. Jacksonville, Fla. | 6530 Supply Row Houston, Tex.

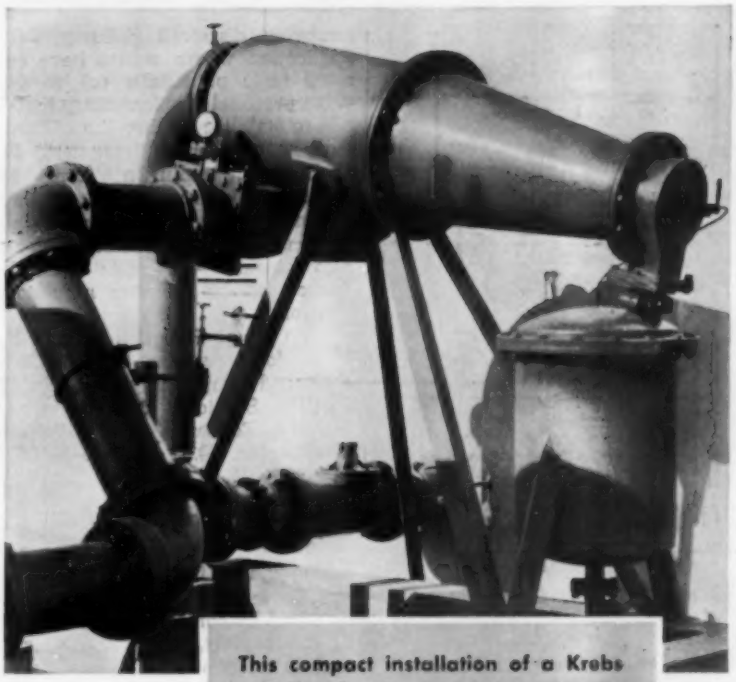
portion of alkaline materials used for neutralization of the acids; 3) Sodium salts are relatively toxic to methane bacteria when added on a slug basis and therefore sodium hydroxide is a poor material to use for neutralization of excess volatile acids.

"Volatile Acid Toxicity in Anaerobic Digestion." By Perry L. McCarty, Assistant Professor of Sanitary Engineering, Mass. Institute of Technology, Cambridge, Mass., and Ross E. McKinney, Professor of Civil Engineering, University of Kansas, Lawrence, Kansas. *Journal WPCF*, March, 1961.

The Water Pollution Image

As the Assistant Surgeon General and Chief Engineer of the Public Health Service, the author has placed before us the problem of water pollution as it is today and what it will be in the future. Earlier in the century public health practice focused on the microbiological factors causing diseases in man with brilliant success—as a result, waterborne epidemics and outbreaks have been virtually eliminated. Today we must become concerned with the new synthetic organic contaminants discharged into our surface and ground water supplies. These organics do not break down like natural organics, are not removed by sewage treatment or normal water purification practices. Included in the contaminants which are introducing new problems are synthetic detergents, pesticides and weedicides, as well as radioactive wastes. More must be learned about their long-range chronic effects; about combinations and about synergistic potentials. In summary, the author states that five factors need to be underscored: 1) There is less and less justification for any city or industry to discharge untreated sewage and wastes to the waters of the U.S., especially the inland waters; 2) For most cities and industries, the treatment requirements will shade upwards from primary treatment to at least secondary treatment for organic pollution; chlorination will be the rule for bacterial reduction; 3) It is important to accelerate promptly the rate of constructing treatment works to the level required to erase the backlog and to keep up with growing needs and obsolescence; 4) A substantial program of research is needed. (a) To assess the public health significance of the growing array of new-type contaminants; (b) To develop practical methods for measuring and for

how Daly City solved sand problems



This compact installation of a Krebs centrifugal water/sand separator, in Daly City, California, replaced two conventional sand traps, and provided substantially increased removal of fine sands.

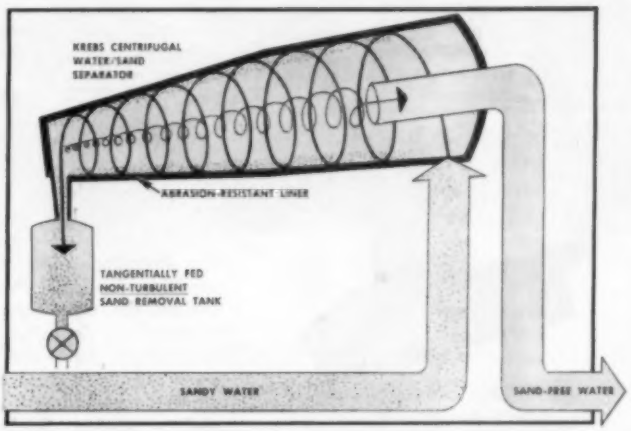
NEW SAND SEPARATOR ELIMINATES:

- clogged meters
- customer complaints
- booster pump wear
- settled sand in pipes

After installing a Krebs centrifugal water/sand separator*, the Daly City, California, municipal water system found immediate benefits in increased revenues and reduced maintenance costs. Their Krebs separator removes 97.8% of the total solids from the well water, and essentially all of the objectionable sand. The unit's efficient separating action results from optimum use of centrifugal force through the cyclonic principle as applied in the exclusive Krebs separator design. Krebs cyclones are accepted as the standard throughout the world in the field of dynamic classification.

Krebs separators are available custom-sized for any municipal well water system. They have no moving parts, require no maintenance, and utilize special sand-resistant liners which will last many years. Installation is simple, and needs a minimum of floor area and headroom. Integral mounting supports are provided; no special platform or framework is required.

*Patent applied for



Write today for descriptive bulletin. Specific recommendations for your own system are available without obligation.

KREBS ENGINEERS INC.

EQUIPMENT ENGINEERS • INC.

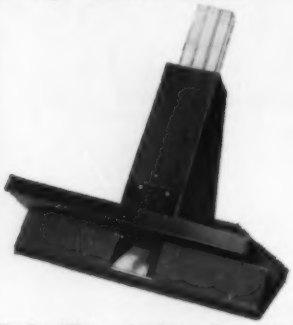
737 LOMA VERDE AVENUE • PALO ALTO • CALIFORNIA

I GOOFED!

(I didn't buy a Taylor Comparator the *first* time.)

I thought comparators were pretty much the same, but was *I* wrong. Broke two of those fragile, individual glass standards the first week . . . and things were really fouled up. Got a Taylor Comparator as soon as I could . . . and I'm really sold on Taylor. You can't beat a slide with the color standards right in it for convenience and easy use.

Taylor Comparators—with guaranteed non-fading color standards in a single slide—let you make fast, easy, accurate tests for pH and chlorine right on the spot. You get dependable data to help you control coagulation, filtration, chlorination and algae in water treatment.



Taylor Water Analyzer for colorimetric water analysis. Also available —Taylor-Enslow Slide Chlorimeter for pH, chlorine tests. Also ideal for control of swimming pool water.

ALL TAYLOR COMPARATORS HAVE GUARANTEED NON-FADING COLOR STANDARDS

SEE YOUR DEALER for Taylor Sets or immediate replacement of supplies.

FREE HANDBOOK, "Modern pH and Chlorine Control". Gives theory and application of pH control. Illustrates and describes full Taylor line.

W. A. TAYLOR AND CO.
7304 YORK RD. • BALTIMORE 4, MD.

removing dissolved pollutants—for application where wastes have serious toxic potentials; (c) to develop practical supplementary methods to stabilize further the effluents from conventional treatment. 5). Considering pollution from all sources, there is real need to update the national system of monitoring streams. Public understanding is also essential—and this must be backed up by effective regulatory controls.

"The Water Pollution Image." By M. D. Hollis, Assistant Surgeon General and Chief Engineer, Public Health Service, Department of Health, Education and Welfare, Washington, D.C. *Journal WPCF*, March, 1961.

"Lake of Sewage" Dried Up

The "Lake of Sewage" underlying the Boise Bench District is being dried up by construction of 95 miles of interceptors, mains and laterals, and 43 miles of service lines which will replace old septic tanks and subsurface leaching fields. This district, consisting of 4,100 acres, adjacent to and part of city limits of Boise, Idaho, houses some 42,000 people. The project, costing about $4,795,000, includes expansion of the Boise sewage treatment plant and sewer construction. A unique three-in-one operation is used to lay 8-inch laterals in trenches less than 10 feet deep. where there is little interference from gas or water services. The nucleus of the operation is a Parson 310 ladder-type trenching machine. A continuous excavating, pipe laying and backfilling operation permits completion of 100 feet of 8-inch sewer line per hour. Excavated material is conveyed back to the installed pipe where screens separate the fines which are tamped around the pipe before the coarser material is deposited. The expansion of the activated sludge treatment facilities includes a 90-foot diameter secondary clarification unit and a sludge thickening process which is somewhat unique. At present. the waste activated sludge goes to the primary tank, combines with the raw primary sludge, is hydraulically drawn into a sludge vault and pumped into one of two primary digesters. Under the new plan. the surplus activated sludge is being wasted into a tank along with the supernatant from the secondary digester. The mixture is aerated and transferred to a sludge thickening tank where the thickened sludge rises, is skimmed off, then mixed with the raw primary sludge and pumped into the digester. This method of thickening a 1½% to 2% sludge to a 3½%, plus dry weight solid sludge was chosen as an alternative to providing more digester capacity.

"Lake of Sewage" Dried Up by Boise Bench Sewer." By A. J. Wahl, Supt., Sewage Treatment Plant, Bench Sewer District, Boise, Idaho. *Wastes Engineering*, March, 1961.

Other Articles

"The Problem: **Sewage Works** Which Start Operating at Low Load and Low Income." Providing for the orderly and efficient development of facilities for separate, independent subdivisions in previously undeveloped areas is one of the challenges facing today's sewage works. By Samuel T. Drew, Radar and Associates, Consulting Engineers. Wastes Engineering, March, 1961.

"Fundamentals of **Sludge Digestion.**" Part II. Biology and Operation. This concluding article gives particular attention to the environment needed for active, effective digestion—effects of pH, temperature, food supply, waste products and others on the process. By Gerson Chanin, Chief Sanitary Chemist, East Bay Municipal Utility District, Oakland, Calif. Water and Sewage Works, March, 1961.

"BOD Removal and Sludge Growth in the Activated Sludge Process." This paper presents some of the formulations available to the engineer for predicting BOD removal and sludge growth under various phases of the biological treatment process. By Brother Joseph McCabe and W. Wesley Eckenfelder, Professor and Head of the Civil Engineering Dept. and Associate Professor of Civil Engineering, respectively, Manhattan College, New York, N. Y. Journal WPCF, March, 1961.

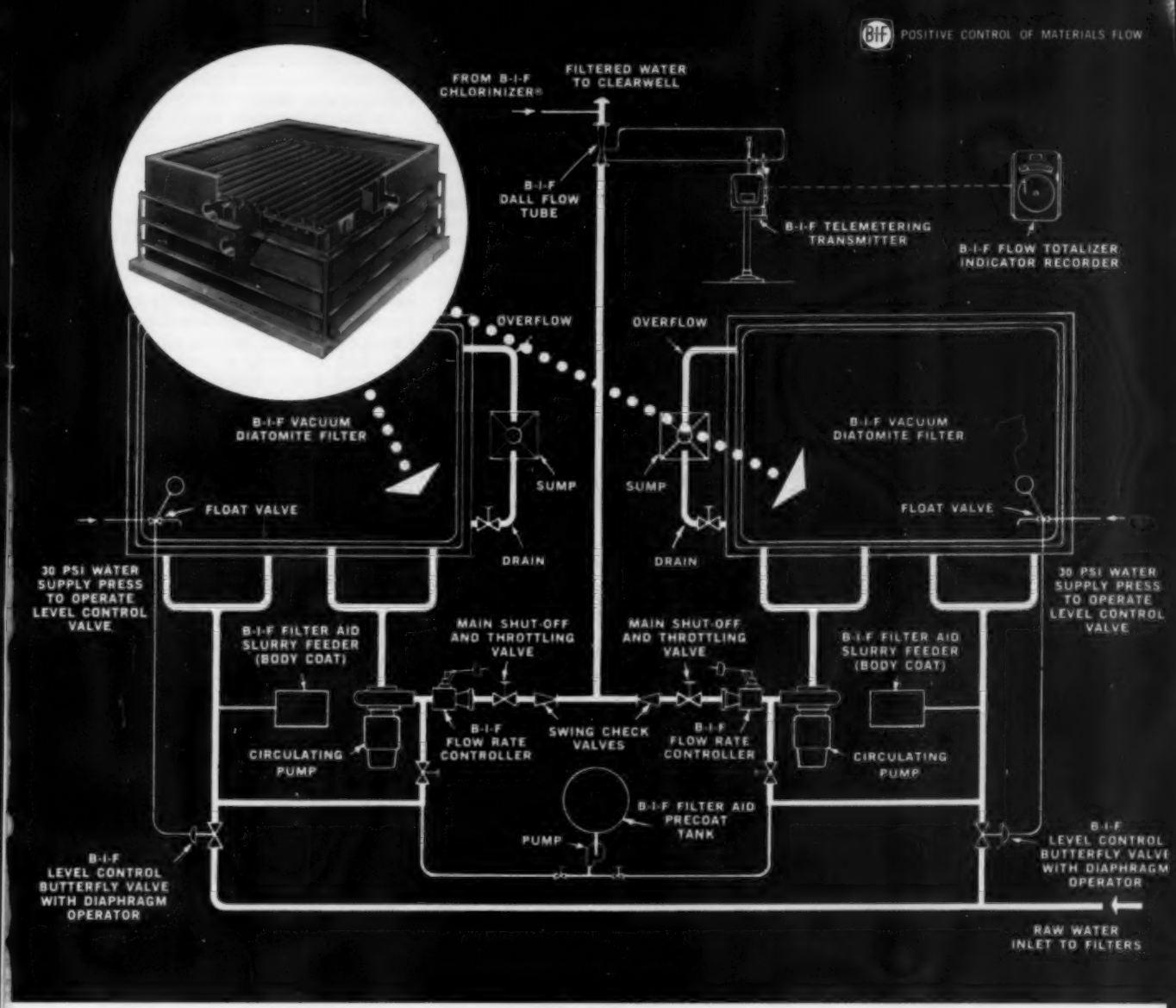
"Algae As A Source of Oxygen in **Waste Treatment.**" A discussion of some of the factors to be considered in using algae as a source of oxygen in waste treatment. By A. F. Bartsch, Assistant Chief, Research Branch, Division of Water Supply and Pollution Control, U. S. Public Health Service, Robert A. Taft Sanitary Engineering Center, Cincinnati, O. Journal WPCF, March, 1961.

"Package Plants for Sewage Treatment." Brief descriptions of 13 package plants on which information was available to the Editor. PUBLIC WORKS, April, 1961.

• • •

Congress on Environmental Health

This second Congress on Environmental Health will be conducted by the School of Public Health of the University of Michigan and the National Sanitation Foundation in collaboration with APHA. The place is Ann Arbor, Mich.; the dates are June 6 to 8. Information from Mr. Harry E. Miller, School of Public Health at the University.


B-I-F POSITIVE CONTROL OF MATERIALS FLOW
FROM B-I-F CHLORINIZER®
FILTERED WATER TO CLEARWELL
B-I-F DALL FLOW TUBE
B-I-F TELEMETERING TRANSMITTER
B-I-F FLOW TOTALIZER INDICATOR RECORDER
OVERFLOW
OVERFLOW
B-I-F VACUUM DIATOMITE FILTER
B-I-F VACUUM DIATOMITE FILTER
SUMP
SUMP
FLOAT VALVE
FLOAT VALVE
DRAIN
DRAIN
30 PSI WATER SUPPLY PRESS TO OPERATE LEVEL CONTROL VALVE
30 PSI WATER SUPPLY PRESS TO OPERATE LEVEL CONTROL VALVE
B-I-F FILTER AID SLURRY FEEDER (BODY COAT)
B-I-F FILTER AID SLURRY FEEDER (BODY COAT)
MAIN SHUT-OFF AND THROTTLING VALVE
MAIN SHUT-OFF AND THROTTLING VALVE
CIRCULATING PUMP
B-I-F FLOW RATE CONTROLLER
SWING CHECK VALVES
B-I-F FLOW RATE CONTROLLER
CIRCULATING PUMP
B-I-F FILTER AID PRECOAT TANK
PUMP
B-I-F LEVEL CONTROL BUTTERFLY VALVE WITH DIAPHRAGM OPERATOR
B-I-F LEVEL CONTROL BUTTERFLY VALVE WITH DIAPHRAGM OPERATOR
RAW WATER INLET TO FILTERS

New **B-I-F** *low cost filtration system meets peak load demands!*

You no longer need high cost expansion to meet peak load demands. At a fraction of the cost formerly required, B-I-F can provide a completely integrated filtration and treatment system. The low installation, operational and maintenance costs save thousands of taxpayers' dollars.

This B-I-F system is built around low cost, performance proven Vacuum Diatomite Filters. The filters' open tank design permits simple visual operation . . . and easier inspection and accessibility. Fiberglass construction eliminates annual painting and repair of protective linings. Chemical pre-treatment is simplified. Wash water requirements are minimized.

From its line of compatible components . . . filters, chemical feeders, instrumentation, butterfly valves, etc. . . . B-I-F will provide a coordinated system to meet your specific peak load requirement. A B-I-F system requires minimum start-up time . . . assures maximum reliability, flexibility for further expansion, and dependable, single responsibility.

Write for the facts! B-I-F Industries, Inc., 356 Harris Ave., Providence 1, Rhode Island.

B-I-F **Industries**

BUILDERS-PROVIDENCE • PROPORTIONEERS • OMEGA METERS • FEEDERS • CONTROLS / CONTINUOUS PROCESS ENGINEERING

Do Consulting Engineering Services Cost—Or Pay?

JOHN GIRAND
President,
Johannessen & Girand,
Consulting Engineers, Inc.
Phoenix, Arizona

THE COMPLEXITY of public works in these days requires careful attention to engineering planning. It is a rare case when a municipality can engage in construction without an extended preliminary investigation and an elaborate set of blueprints prepared by skilled engineers.

The cost of this planning, engineering design and preparation of plans for construction has become an important part of the total project cost. For example, testimony given to the House of Representatives Public Works Appropriation Sub-Committee indicated that one highway department spends more than 13% of the construction costs of its highways in preliminary planning, design, preparation of construction plans and specifications, and more than 10% in construction engineering.

The cost of engineering performed by some municipalities is difficult to determine due to the method used by these municipalities in keeping books. For example, a southwestern city of about 500,000 population (which has received numerous awards during the past decade for excellence of municipal operation) does not report in its annual budget the cost of engineering on projects financed by bond issues. In the budget, detail on the engineering department does not show any continuing costs for overhead items such as rent and insurance. In addition, engineers are scattered through other departments such as Traffic Safety, and Water and Sewer Departments, which makes it virtually impossible without an elaborate audit to determine how much money is actually spent on the engineering phases of this particular municipality.

The budget for another southwestern community with a population of approximately 250,000, carries items, which might be engineering, under Public Works Services, Streets and Highways, Traffic Control, Planning and Zoning, in such a form that it is difficult to determine the actual money spent on engineering without an audit.

Under these circumstances, it is not easy for municipal administrators or policy makers, such as city councils, to determine whether or not engineering departments are over staffed, under staffed, or have come under the influence of *Parkinson's Law*, which states that the workload adjusts itself to the number of employees on hand.

Functions of Engineering

It might be helpful in an analysis of this sort to separate the functions of engineering into certain areas. With such a separation, areas are found which may be compared and other areas are isolated so that if comparisons cannot be made, at least the amount of money spent can be determined.

One such breakdown would separate the engineering into two major categories, the first being the continuing day to day engineering required by any municipality, and the second, the special projects of a non-repetitive nature which occur relatively infrequently.

Projects in the first group are usually handled by a normal work force which could well be comprised of civil service employees with routine day-to-day duties which do not vary. Such projects as keeping the maps of the water department up to date, keeping records of property surveys and subdivisions or preparing routine answers to the many inquiries that come from municipal residents, all are part of the day to day operation of the engineering department.

The second category could include such projects as a new treatment plant, the construction of a runway at the local airport, or the control surveys of newly annexed areas.

With respect to work of the second category, there is a substantial area of comparison of the cost of engineering on projects of this nature. Many political subdivisions supplement their engineering staff for peak load requirements by employing private consulting engineers. These private firms are required to keep adequate financial records. Few firms without financial control stay in business very long, and all firms are required to report income to the Federal and State Governments.

Factual information on the cost of engineering projects performed by private engineering firms on typical municipal projects is included in Table 1. These costs are taken from current projects, all of which were designed and constructed within the past two years, and represent typical practice for communities west of the Mississippi. The figures were furnished by a private engineering organization and include all items of overhead such as rent, taxes, employee fringe benefits (vacation, sick leave, hospitalization, life insurance, retirement fund).

This type of information can be used by municipal administrators or city councils as a guide to what general engineering costs might be. But it should be remembered that these costs will vary widely and for any one particular project can be two to three times the figures quoted and not be out of line. For example, one government agency furnished information to a House Committee on Appropriations which indicated that engineering design costs on projects performed by that agency's personnel amounted to about 7 percent of the project costs and another 7 percent was required for administrative and construction supervision to bring the total to 14 percent.

The important thing to determine is not only what the engineering is costing but what the municipality is getting for its money. In most instances, administrators and municipal officials can insure competent engineering performance by their own departments (as well as consultants who might be employed) by first establishing a criteria of what the project should accomplish and then periodically reviewing the project after it is put in operation to see how well the project accomplishes the purpose for which it was designed.

For example, many engineers believe that there is some latitude permitted in the design of a water works and that such design includes assumptions which depend upon judgment. One engineer might select an 8-in. pipe for a particular water line while another would select a 10-in. pipe. To determine which one is right is almost impossible and about the only effect on the project would be that the 10-in. pipe would result in somewhat higher pressures with slightly higher construction cost while the 8-in. pipe could result in lower pressure with lower construction costs. It is

doubtful, however, that the average municipal water consumer would recognize the difference in pressure at the kitchen faucet of between 30 and 40 psi, or, at any rate, it is doubtful that this difference in pressure would be enough to cause many consumer compaints. Yet, this difference in size of pipes would result in a higher construction cost for the larger pipe. Determination of water loading on a complicated loop in most municipalities is not an exact science, and the 8-in. or 10-in. pipe projects should not be compared on the cost basis alone.

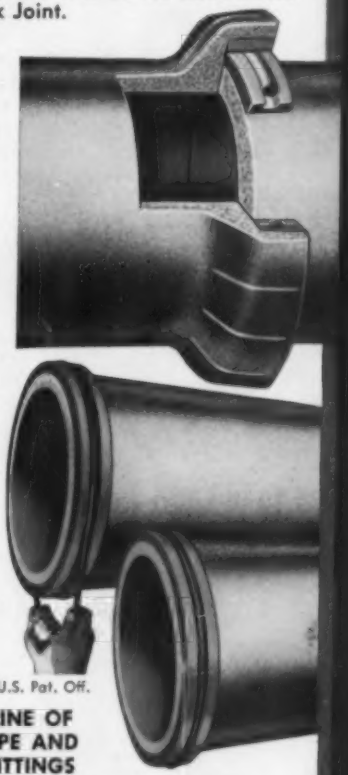
If municipal administrators would establish desired results prior to assigning the engineering, either to their own departments or to private firms, and then later check the performance of the engineers, a comparison of costs could then be obtained. Without such standards, the costs of engineering can mean very little.

Table 1—Engineering Costs on Municipal Public Works Projects

Type of Project	Construction Costs	Engineering Costs	Percentage	Remarks
8 Miles 30" Sanitary Sewer	$ 773,398	$ 21,390	2.76	Complicated sewer design. Many underground obstructions, railroad crossings, traffic hazards, bad trenching conditions.
1 Mile 30" to 60" Storm Drain	225,115	10,120	4.50	Includes concrete structure at each change in pipe size
14 Miles of Highway Design (Interstate)				
a. Expressway	3,950,000	130,504		Uncomplicated, open country, simple bridges
b. Bridges	1,250,000	14,596		
Total	5,300,000	172,100	3.30	
Concrete Pavement for Heavy Aircraft	1,167,276	52,527	4.50	Includes complicated rerouting of underground utilities, complicated construction scheduling to prevent interruption of air traffic.
3 Miles 6"/8" Sanitary Sewer	250,000	12,000	4.8	District Improvement Act Project. Elaborate paper work; design, construction simple.
Airport Runway Strip 2600' length	89,235	7,146	8.0	Runway for small single engine planes.
1.46 miles downtown street widening	485,640	24,282	5.00	Complicated right of way problems. Short blocks. Many difficult intersections.
4.6 Miles of 40' County Highway	320,595	22,092	7.0	Rolling country, average side drainage culverts, asphalt pavement, good subgrade.
Expressway Interchange	1,500,000	60,645	4.62	Complicated expressway interchange. Foundations good. Construction standard. 3-Structure lace type interchange.
Water Treatment Plant	3,144,780	141,515	4.5	All new open construction.
60" Water Line	2,698,274	101,185	3.75	Complicated water line design. Railroad and many utility crossings. Traffic hazards.
Addition to Sewage Plant	556,000	26,020	4.5	Expansion and additions to existing facilities.

NEW!
EVANS
Wedge-Lock*
TYPE "O" JOINT
SEALS VITRIFIED PIPE
FASTER, TIGHTER THAN EVER BEFORE!

Available now on large diameter Vitrified Pipe, Evans' new Type "O" Joint provides the same tight seal and minimum infiltration characteristics as the double-ball Wedge-Lock Joint.



Cut-a-way view shows points of compression.

Evans Type "O" Compression Joints are permanently bonded to the pipe to provide a tighter, longer-lasting seal.

Rubber gasket ring slips over spigot joint... helps create uniform high compression around the entire circumference of the pipe.

*Pat., T.M. Reg., U.S. Pat. Off.

COMPLETE LINE OF VITRIFIED PIPE AND MATCHED FITTINGS

- DoubLength — Twice as Long as Ordinary Pipe
- Conventional Bell-and-Spigot
- Wedge-Lock Factory-Made Compression Joints
- Die-Cast Factory-Made Bituminous Joints

One of the nation's largest producers of Face Brick, Clay Pipe, Flue Lining, Wall Coping, Plastic Pipe, and related construction materials, known for over 50 years for faster, friendlier service.

THE EVANS PIPE COMPANY

GENERAL OFFICES, UHRICHSVILLE, OHIO
TELEPHONE WAlnut 2-4210

E-560-7

THE INDUSTRIAL WASTE DIGEST

Prepared by **CLAYTON H. BILLINGS,** *Associate Editor*

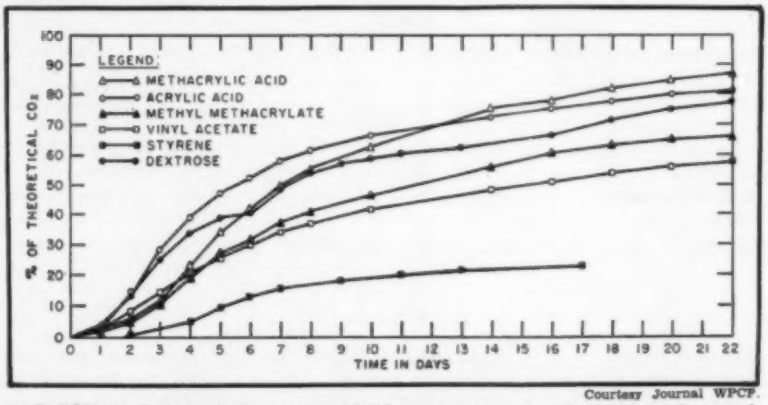
Bio-Oxidation of Resistant Vinyls

The potential damage to a stream by the presence of organic chemicals which are not rapidly oxidized, is difficult to assess by tests based on biological oxidation requirements. Among such chemicals are the vinyl monomers, on which there is a dearth of information available. Accordingly, an investigation was made of the biochemical oxidation characteristics of vinyl compounds in dilute solutions. The analytical apparatus consisted of a bench scale oxidation system arranged in three parallel units, all of which contained seeded BOD dilution water. Vinyl compounds were added to two of the systems and the third was used as a control. Compressed air fed to the systems was subjected to a carbon dioxide absorption apparatus. Barium hydroxide gas absorbers were installed on the exhaust air lines also, so that carbon dioxide production in the system could be measured, and thus be considered as evidence of breakdown of the organic chemicals. The compounds tested were acrylic acid, methyl methacrylate, methacrylic acid, vinyl acetate, styrene and dextrose. In each case the concentration used was 10 mg/L. The dextrose solution oxidation test was employed to gauge the efficiency of the system with respect to an easily oxidized compound. Since only 83 percent of the carbon dioxide theoretically available was recovered, it was apparent that part of the compound tested is used to form cell protoplasm. Acrylic acid and methacrylic acid were as easily oxidized as dextrose. In the case of all vinyl compounds except styrene, the vapor pressure of the compound and consequently degree of volatilization had an inverse effect on carbon dioxide production because with volatilization, less of the chemical is available for oxidation. Styrene is partially insoluble at the concentrations used and the insoluble portion volatilized before oxidation could occur. After oxidation was assumed complete, infrared analyses of the vinyl compounds indicated that no intermediate oxidation products were formed.

"Biological Oxidation of Several Vinyl Compounds." By H. R. Pahren and Don E. Bloodgood, Purdue University. *Journal WPCF*, March, 1961.

Industrial Waste Charges in England

In Birmingham, England, there is a concentration of engineering and metal finishing industries employing over 300,000 people with about 300 firms employing less than 300 and over 1,600 employing less than 100. More than half the dry weather flow of sewage from Birmingham, averaging 50 mgd, is trade effluent. With the flood of acidic effluents, justifiable pressure was brought to bear by the Drainage Board for control of trade waste discharge practices. Since March, 1956, Birmingham has negotiated and issued 460 "consents" bringing that number of industries into a complex trade effluent charging scheme. This is expected to be increased to 650 by 1962. The first part of the charge is for reception of the effluent, based on the cost of maintenance and loan of the sewer system. For 1960-61, the charge is 1.90 pence per 1,000 gals. The charge for treatment is varied twice yearly with strength of the effluent to provide incentive to reduce pollution load. The charge is apportioned between sedimentation, oxidation and sludge treatment, as 25, 50 and 25 percent respectively. The basic charges for oxidation and sludge treatment are for the maximum conditions of the consent, with actual charges occurring as a fraction of the maximum, in proportion to the ratio of actual to maximum strength. For 1960-61 the basic charges for sedimentation, oxidation and sludge treatment in pence per 1,000 gals. were 1.44, 2.88 and 1.44, respectively. The limits normally imposed by the consent are suspended solids 400 ppm; soluble metals 10 ppm; cyanide 10 ppm; BOD 322 ppm; and O.A. 125 ppm. These limits cannot be exceeded. The minimum charge is 5 pounds per year. Volumes of flow are calculated from water bills. In general, one sample from a given industry


LEGEND:
METHACRYLIC ACID
ACRYLIC ACID
METHYL METHACRYLATE
VINYL ACETATE
STYRENE
DEXTROSE
% OF THEORETICAL CO_2
TIME IN DAYS
0 10 20 30 40 50 60 70 80 90 100
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22

Courtesy Journal WPCF.

● **PERCENT of theoretical recovery of CO_2 versus time for the compounds tested.**

Install in less than a day by specifying a factory-built sewage pumping station that is delivered to the job site, ready to install. **For more information, write Dept. 40.**

S&L Smith & Loveless Factory-Built Sewage Pumping Stations are designed for economical installation, engineered for minimum maintenance, and built to last a lifetime of dependable service.

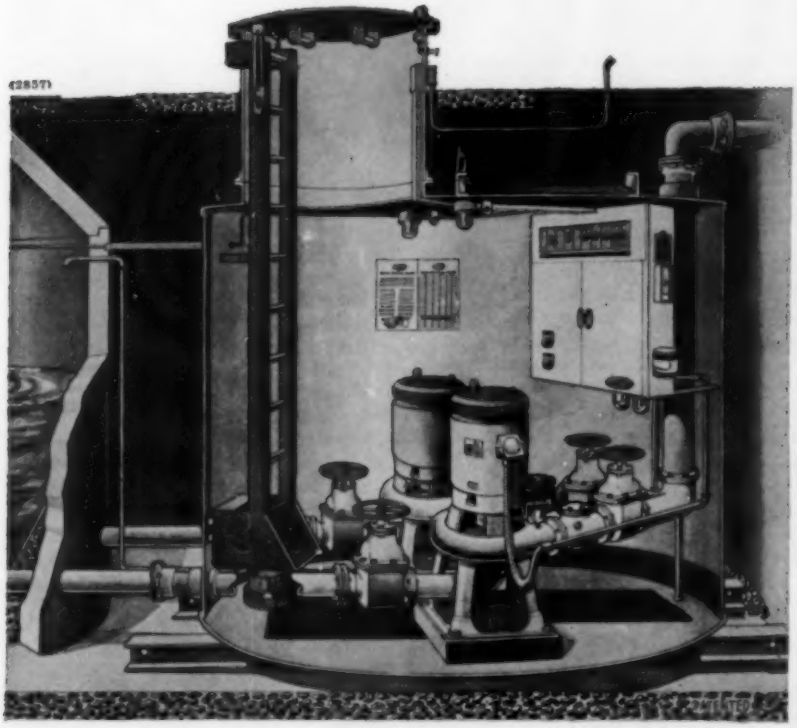
Smith & Loveless is the world's largest manufacturer of complete, factory-built sewage lift stations with over 1,600 varied installations all over the United States, including Alaska and Hawaii—even Europe and South America, as well as Canada.

Smith & Loveless sewage pump stations are available for capacities from 100 to 4,500 GPM per pump with two, three and four pumps per station and a wide variety of control systems including variable speed controls and flow-matching systems. Even larger capacity stations are built to order.

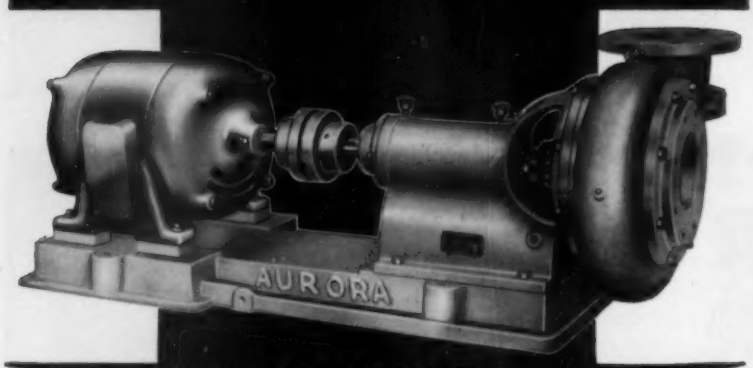
Smith & Loveless

P. O. BOX 8884 / KANSAS CITY 15, MISSOURI
PLANT: LENEXA, KANSAS

ONE OF THE UNION TANK CAR COMPANIES



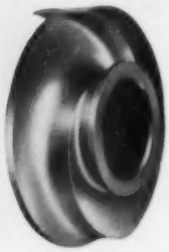
AURORA® CONTROLLED PERFORMANCE



MONO-VANE

NON-CLOG PUMPS

"The Pump with the single passage impeller"



MONO-VANE IMPELLER

- CAPACITIES TO 1000 G.P.M.
- HEADS TO 150 FT.
- BALANCED IMPELLER
- HORIZONTAL OR VERTICAL
- RUGGED CONSTRUCTION
- PROVEN DEPENDABILITY
- MINIMIZED WEAR
- FAST INSTALLATION
- EASY MAINTENANCE

The Mono-Vane impeller is in hydraulic and dynamic balance. It can be trimmed to suit various head and capacity requirements and still retain proper balance. The AURORA Non-Clog Pump is ideal for handling long stringy materials. Smooth, quiet operation is assured with the Mono-Vane impeller which is always in dynamic and hydraulic balance—even when trimmed to accommodate various head and capacity requirements. Single passage impeller design makes the AURORA Non-Clog pump ideal for handling long stringy materials. The discharge may be turned to any position to facilitate installation, service and maintenance. Clean-out cover is located in casing to provide easy service access.

Typical applications: elevating sewage, pumping sludge, handling heavy settleable solids, effluent, and other wastes and industrial by-products.

WRITE FOR BULLETIN 121 MV

AURORA Always PUMPS

AURORA PUMP DIVISION
THE NEW YORK AIR BRAKE COMPANY
630 LOUCKS STREET • AURORA • ILLINOIS

LOCAL DISTRIBUTOR IS LISTED IN THE YELLOW PAGES OF YOUR PHONE BOOK

is collected per month. For administration of the charging system, the city is divided into five districts, with each area managed by four men. Laboratory work is performed in a central location. The charges are determined by an electronic computer which prints the bills ready for posting at the rate of 600 per hour.

"Trade Effluent Control on a Large Scale." By S. J. Asher and K. Wakeham. *The Surveyor* (London), February 25, 1961.

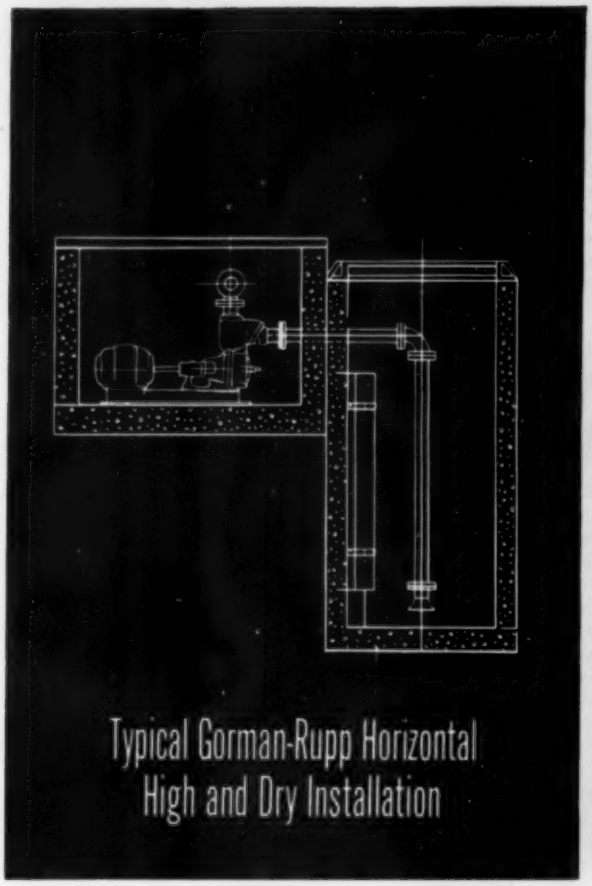
Steel Plant Smoke Abatement

In 1957, upon the invitation of the American Iron and Steel Institute, the Battelle Memorial Institute commenced an investigation to establish means for control of smoke from the Bessemer steelmaking process. This article is a progress report on the investigation. In the Bessemer process, pig iron is decarbonized by forcing a blast of air upward through a bath of molten metal, resulting in the discharge to the atmosphere of large quantities of smoke-laden exhaust gases. To collect, cool and clean the exhaust gas would be a tremendous problem; hence, the efforts of the Battelle Institute are devoted to seeking other methods of abatement. The feasibility of preventing the formation of smoke is deemed the most desirable method of attack. The emissions of a typical Bessemer acid converter were sampled to obtain complete information on the problem. It was found that the particles present are about 90 percent iron oxide with about 0.2 lb. of dust per 1000 lb. of gas with an air blow and 0.08 lb. per 1000 lb. with a steam-air blow. Many of the particles are smaller than a micron and more small particles are produced with an air blow than in a steam-air blow. To further the investigation a laboratory converter was built, simulating in operation a full-scale vessel. Thus far, the study has included verification that the performance of the laboratory converter is comparable to full scale operation; investigation of smoke density and exhaust gas composition; and investigation of the effect of blast gas additives such as hydrogen, steam, other hydrogenous gases and sodium chloride in preventing smoke formation. While some methods have shown evidence of reducing smoke production, no conclusions have so far been reached.

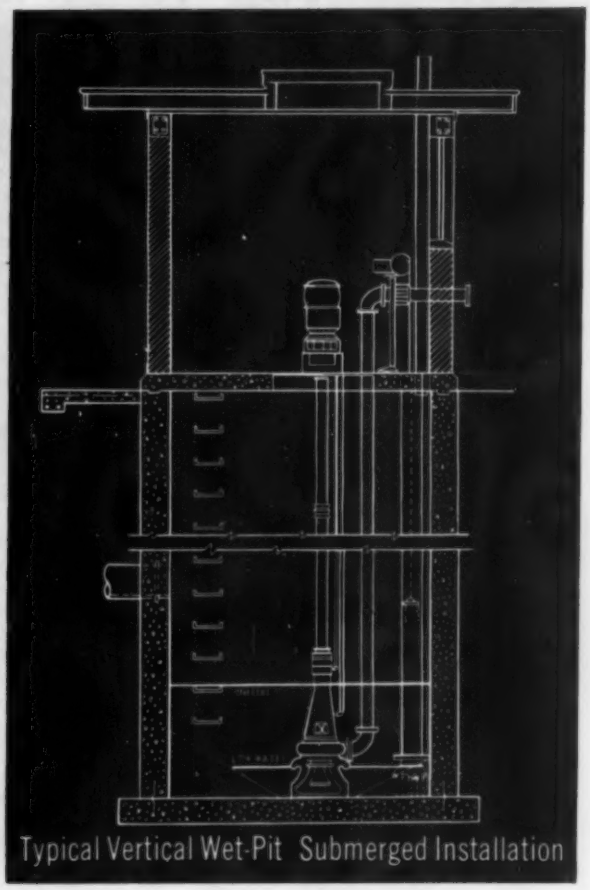
"Research on Control of Emissions from Bessemer Converts." By A. R.

SAVE UP TO 50%...

GORMAN-RUPP Sewage Pumps



Typical Gorman-Rupp Horizontal High and Dry Installation



Typical Vertical Wet-Pit Submerged Installation

A glance at the two diagrams above will quickly show simplicity of installation. Further study of equipment costs will add to the proof of savings when you install Gorman-Rupp High-and-Dry Sewage Pumps. These economies are possible through design features which permit self-priming in lifts up to 15 feet, positive action, and nearly complete avoidance of clogging.

Gorman-Rupp Sewage Pumps need almost no maintenance compared to submerged pumps. No need to service by entering pit or raising pump. Just a turn of the handle and the end plate is off.

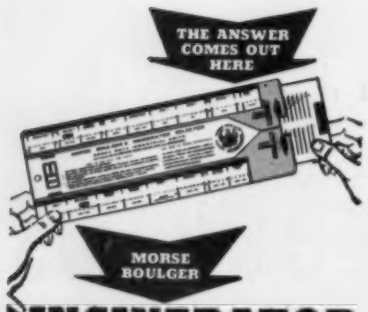
In lift stations and sewage plants, these Gorman-Rupp units have shown amazing savings . . . operating where others have failed. 2", 3", 4" and 6" pumps —connected to your power or ordered complete with power units. Write for specifications.

THE GORMAN-RUPP COMPANY

305 Bowman Street Mansfield, Ohio

Gorman-Rupp of Canada, Ltd., St. Thomas, Ontario

In Jacksonville, Florida, a 3-inch Gorman-Rupp Pump replaced a submerged pump after 2½ years in service.



INCINERATOR SELECTOR

A handy, pocket-size device, designed by our engineers to make life easier for you. Complicated computations are eliminated. At a glance you see the type and size Morse Boulger Incinerator Unit required for your specific job.

FREE One of these tremendous time-savers will be sent free upon request. (Extra "Selectors" $3 each, 4 for $10).

MORSE BOULGER DESTRUCTOR CO.

Today's engineering plus more than 70 years experience building incinerators of all types and sizes.

80 FIFTH AVENUE
NEW YORK 11, N. Y. Dept. 75
REPRESENTATIVES EVERYWHERE

Member: Incinerator Institute of America
Air Pollution Control Association

BUILD BETTER SEWER LINES

with
WESTON
GASKETS and FORMS
for
SEWER PIPE JOINTS
(a cement joint)

- No jute used—gasket centers spigot.
- Definite space in each joint for cement.
- Form confines cement-grout to lower portion of joint.
- Particularly advantageous in water-bearing trenches.
- Infiltration minimized.

L. A. WESTON CO.
Adams Mass.

Orban, J. D. Hummell and G. G. Cocks, Battelle Memorial Institute. *Journal Air Pollution Control Association*, March, 1961.

Analysis for Radium in Water

The occupational maximum permissible concentration of radium-226 in water is 10^{-7} μc per ml. For use by the general public, levels of one to 10 percent of this area of interest and should be detectable by means available to laboratory technicians employed by public water supply agencies. The radium can be carried on barium sulfate for determination by alpha counting, and this method is preferred over that of determination through the radon daughter, requiring special equipment. In using the barium sulfate method, problems arise through premature precipitation of the sulfate ion from the presence of sulfate in water. Interference is also to be anticipated from other substances in water and other alpha emitters in larger quantities. In a method developed especially for water supply technicians, radium is concentrated from solution by coprecipitation with mixed barium and lead sulfates. By adding the barium and lead carriers to a solution of alkaline citrate, precipitation is hindered until interchange of radium and barium is completed. Precipitation is then accomplished by sulfuric acid. The barium sulfate is purified by nitric acid washes and is reprecipitated from EDTA solution by treatment with acetic acid. The EDTA masking allows decontamination of the barium sulfate from other alpha emitters and lead. This EDTA-acetic acid cycle can be repeated as often as necessary to effect a high degree of purification. The reprecipitated barium sulfate is then transferred to a planchette for counting.

"Determination of Dissolved Radium." By A. S. Goldin, R. A. Taft Sanitary Engineering Center. *Analytical Chemistry*, March, 1961.

Aerobic Digestion For Poultry Wastes

Poultry processing has developed into a high volume-low unit cost operation, with some plants packing 100,000 chickens per day. The wastes produced result from processing and from clean-up, with 25 percent of the water usage occurring from the latter. If blood is not recovered, it may account for 40 percent of the BOD load of the processing waste. Feathers and offal should be removed from process waste streams by mechanical screening, so that the liquid waste from a well-operated plant will contain only small amounts of flesh, feathers, grit, feed, dirt and blood (depending on whether blood recovery is used). Experience has shown that aerobic digestion can provide a satisfactory degree of treatment for the wastes with a minimum amount of operating attention. The ability of a specific plant to function under varying conditions of load was observed to help define criteria for future design of aerobic digestion systems. When the poultry plant was recovering blood the waste BOD was less than 200 mg/L; however, under a maximum processing load and with blood discharged to waste, the average BOD attained a figure of 1000 mg/L. Assuming an average loading of 15 lbs. of 5 day BOD per day per 100 lbs. of mixed liquor suspended solids and that a concentration of 5,000 mg/L of mixed liquor solids can be maintained, a reasonable volumetric loading is 45 lbs. of 5 day BOD per day per 1,000 cu. ft. The final clarifier design is critical with respect to surface overflow rate, which should not exceed 1,000 gpd per sq. ft. Air requirements are 1,500 cu. ft. per lb. of BOD to be removed.

"Chickens for the Barbecue—Wastes for Aerobic Digestion." By G. H. Telezke, Eimco Research and Development Center. *Wastes Engineering*, March, 1961.

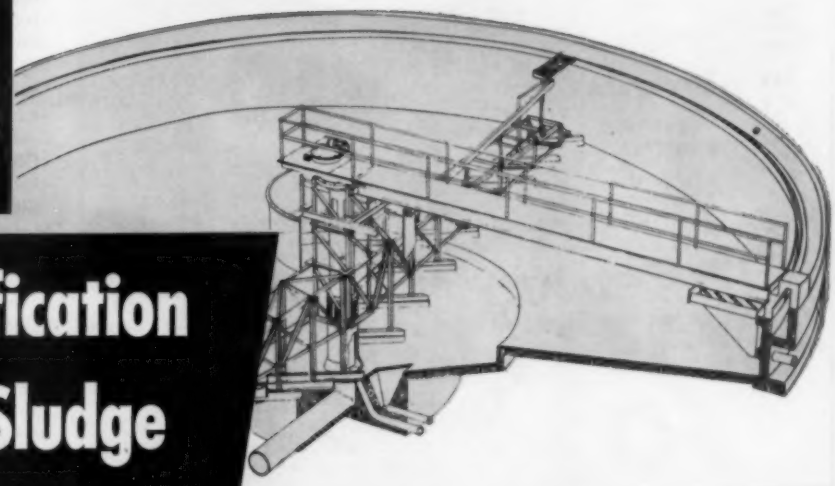
• • •

Salt Use in Winter Maintenance

All major turnpikes and toll roads and 38 states in the snow belt use salt in their winter maintenance. Spread at the rate of 500 pounds per mile of two-lane roadway a one-man, 4-ton truck can work up to 16 miles in one pass without reloading. This is eight times faster than the customary application of two tons of abrasives per mile for the same pavement.

In heavy and continuing storms, alternate salting and plowing may be employed to increase the efficiency of the plows and avoid spots of icy residue left during plowing. Salting after plowing prevents dangerous areas of packed snow and ice and helps eliminate the problem of re-freezing. Some communities and shopping centers apply salt before a storm to keep the snow from packing and bonding to streets and sidewalks. Plowing or shovelling is then easier, and more effective.

Protecting your water resources



Clarification and Sludge Thickening

in a single tank!

Eimco-Process Clari-Thickener

multi-purpose sewage treatment unit

Many sewage treatment plants can now get all the advantages of clarification and separate thickening facilities without the expense of adding a sludge thickening unit to the treatment system.

New Eimco-Process Clari-Thickener treatment unit combines primary or secondary clarification and sludge thickening in a single multi-purpose unit. Sludge densities of 8 to 12 per cent solids are obtained. Clarification efficiency is excellent. Complete control of septicity is achieved.

The Eimco-Process Clari-Thickener unit incorporates a separate thickening compartment within the clarification section for holding settled sludge 12 to 24 hours for thickening to maximum density.

Septic conditions are prevented by the introduction of an oxidative liquid which forms a blanket zone over the thickening compartment during holding periods. This liquid displaces the liquid in the sludge, keeping solids fresh. The amount of oxidative liquid introduced can be adjusted to suit operating conditions.

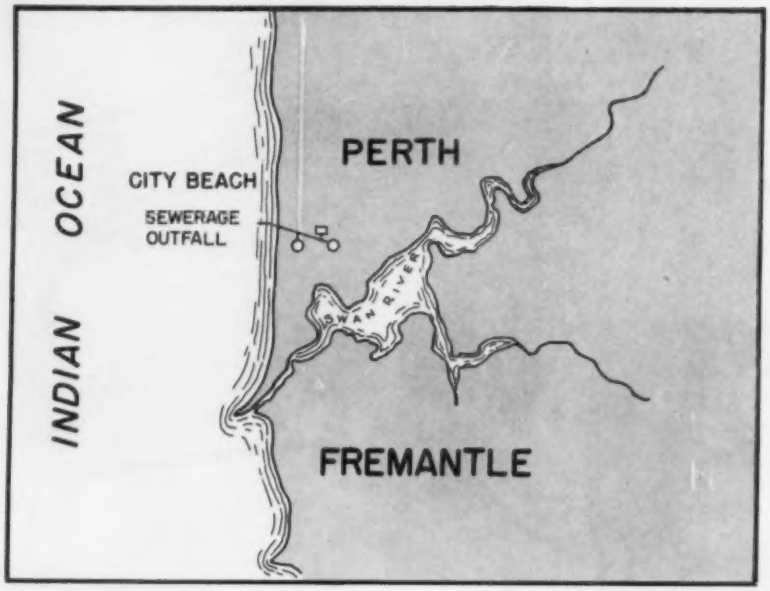
Find out how the Eimco-Process Clari-Thickener unit can help you get greatly improved treatment, economically. The Eimco-Process representative in your area will be glad to meet with you and your engineers. Call him. And write Eimco's Process Engineers Division for new Bulletin SM-1018.

Clari-Thickener and Thixo are trademarks of The Eimco Corporation.

THE EIMCO CORPORATION

B-707

Process Engineers Division
420 Peninsular Avenue,
San Mateo, California



Typhoid Traced to Bathing at a Polluted Beach

A PORTION of the report of the Commissioner of Public Health for Western Australia for the year 1958 has been forwarded to us by Harold Romer, Director of the Bureau of Sanitary Engineering of the New York City Department of Health, 125 Worth St., New York 13, N. Y. The essential portion of the report relating to the occurrence of typhoid fever among users of this beach is reproduced below. In his forwarding letter, Mr. Romer summarized some of the factors inherent in diseases that may be contracted by bathing in polluted water. He especially requests that any of our readers who have information on occurrence of any disease, reportable or otherwise, resulting from bathing in polluted water send such data to him.

The portion of the report which relates to this outbreak follows:

"Typhoid infections occur from time to time in almost every modern community. In the more advanced communities, however, incidence of the disease is low, and comprises a few apparently unconnected cases occurring at relatively wide intervals of time. Despite conscientious investigation designed to identify the origin of these individual infections, only in uncommon instances is the source identifiable. The majority defy detection, and are generally presumed to be due to food contamination by unrecognized carriers (who may have suffered from the disease several decades previously).

"Typhoid in Western Australia during recent years has conformed to this general pattern. An average of nine cases has been customary each year. Most of these cases have been unrelated one to another and investigations by local health officers, assisted by the Department, have been largely unsuccessful. Only rarely has an associated carrier been identified and placed under permanent surveillance.

"A rapid sequence of eight notifications during the early part of 1958 was therefore recognized as most unusual; and a possibility that some common source of infection might exist was at once apparent. The routine inquiries conducted by local health authorities were therefore intensified and co-ordinated by the Department. The vehicles of infection incriminated in other outbreaks elsewhere received specific attention. These included contact with known cases or carriers, and food such as ice cream, shellfish, desiccated coconut, prepared meats and salads. None of these appeared to be implicated; but it was discovered that several of these early patients had bathed regularly at City Beach. This factor was reinvestigated and it was found that not only had five of the first eight cases bathed at City Beach, but they had done so more frequently and for longer periods than the average beach visitor. Further, one of them (together with a companion) had on a recent occasion left the water because he had found it offensive.

"The status of the sea water at City Beach was immediately looked into, and a number of disturbing disclosures resulted:

"1. The treatment of sewage at the main metropolitan plant in Subiaco was incomplete.

"2. The outfall from this sewage plant lay approximately one mile south of the City Beach bathing area.

"3. The weekly samples of City Beach sea water had contained a very high concentration of fecal organisms on at least two occasions during February.

"4. An aerial photograph showed a zone of ocean discoloration originating at the outfall and involving the City Beach bathing area; and swirls indicated that the outfall pipe (about 300 feet long) was broken in two places.

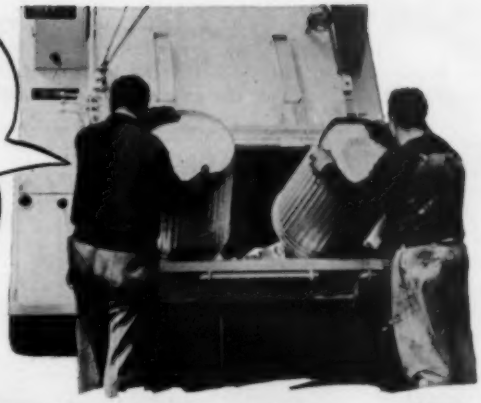
"On March 12th the Minister for Works (who was also acting Minister for Health at the time) was apprised of these findings and advised to close the beach as a precautionary measure while further investigations proceeded. The Minister accepted this advice and immediately issued a warning to the public to refrain from bathing at City Beach until further notice.

"During the next three weeks, seven additional typhoid cases occurred. Five of these had been associated with City Beach prior to its closure; while one of the remaining two was traced to a carrier. The outbreak then terminated and no further notifications were received for many weeks.

"Thus, of the 15 cases which comprised the outbreak, 10 were associated with City Beach and one was due to a carrier. The origins of the four remaining were not identified.

"The evidence incriminating City Beach was further strengthened when the results of 'phage' typing of the strains of *Salmonella typhi*, recovered from the patients concerned, became known. These had been sent to Melbourne for identification and it was found that the causative organisms involved were of five different types. A 'mixed bag' such as this eliminated the possibility of the outbreak being due

If the men who buy refuse collection units would ride the routes, they'd buy ROTO-PAC every time!



AND HERE'S WHY—

We don't waste time standing around waiting for the hopper to be emptied, because...

ROTO-PAC IS CONTINUOUS

We do less lifting because some stops now use power-handled Containers as big as 6 yds.

ROTO-PAC IS EASIER

We get through quicker and get home earlier, because...

ROTO-PAC IS FASTER

Get the ROTO-PAC story—

including a Container System which can be added when desired. Same unit handles BOTH manual and container loading.

CITY TANK CORPORATION

(A Unit of Hagan Industries, Inc.)

CULPEPER, VA. • VAlley 5-8356

to 'carrier contamination' of some common foodstuff and strongly indicated a conglomerate source of infection such as sewage-polluted water.

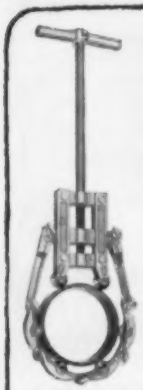
"The pollution of bathing places is a constant source of anxiety to health authorities all over the world; and it is customary for these to be kept under constant bacteriological surveillance. Nevertheless, convincing evidence to incriminate bathing in polluted sea water as a cause for outbreaks of intestinal disease is extremely hard to find. This is not surprising. The self-purifying effects of sea water are numerous. Dilution, aeration, salinity, sunlight, predatory bacteria and other factors combine to bring about the destruction of typhoid and other organisms which are discharged into the sea. For this reason it is virtually impossible to demonstrate the presence of pathogenic bacteria in small incidental samples of sea water examined by standard techniques. On the other hand it is known that the infective dose of *Salmonella typhi* is minimal and minute, and that typhoid organisms are capable of surviving in sea water for appreciable periods. It is also evident that the degree of pollution at a point some distance from a sewage outfall would vary according to prevailing winds and currents; and that in the situation described, the overall hazard would be relatively small, intermittent, and brief. This indeed may have accounted for the limited number of bathers affected."

COLOR PHOTOS CHECK SEWER COATINGS

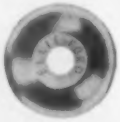
REMOTE control camera inspection of a 24-in. concrete combination sanitary-storm sewer line has recently been completed by the Jersey Testing Laboratories, Inc., of Newark, working with the cooperation and sponsorship for the Jersey City Sewerage Authority and Koppers Co., Inc. Color photographs of some 823 feet of pipe interior showed the test engineers that the Bitumastic coal-tar, cold-applied protective coating in the pipe was still in perfect condition after more than four years of use with abrasive flows ranging from 0.5 to 2 mgd.

The waterproof 16mm camera, mounted on steel runners and carrying its own strobe-light source, was conveyed along the length of the pipe by a special cable-pulley arrangement. It automatically triggered the shutter for a 360° picture at 2-ft. intervals. Trial runs were repeated several times to check lens settings and assure complete coverage of the pipe's interior coating surface.

● **SPECIAL camera used for sewer inspection has self-contained light source.**



Ellis Heavy Duty Pipe Cutters For Pipe Up To 16" Dia.



With Long Lasting Cutter Wheels

Designed for water works men who appreciate the rugged construction of drop-forged frame and links; and a tool that assures no pipe breakage, no re-cutting and no spoilage.

THREE SIZES

No. 01 for 4" to 8" Pipe
No. 1 for 4" to 12" Pipe
No. 1B for 4" to 16" Pipe

write today for free literature

ELLIS & FORD MFG. CO.
1100 COOLIDGE RD.
BIRMINGHAM, MICH.

Rugged transistorized construction practically eliminates maintenance costs...extends battery life to a year or more. Pinpoint accuracy, greatest depth penetration make the M-scope first choice in the field! Only $189.50

Send for FREE catalog

SINCE 1932
Fisher RESEARCH LAB., INC.
Dept. PW-7, Palo Alto, Calif.

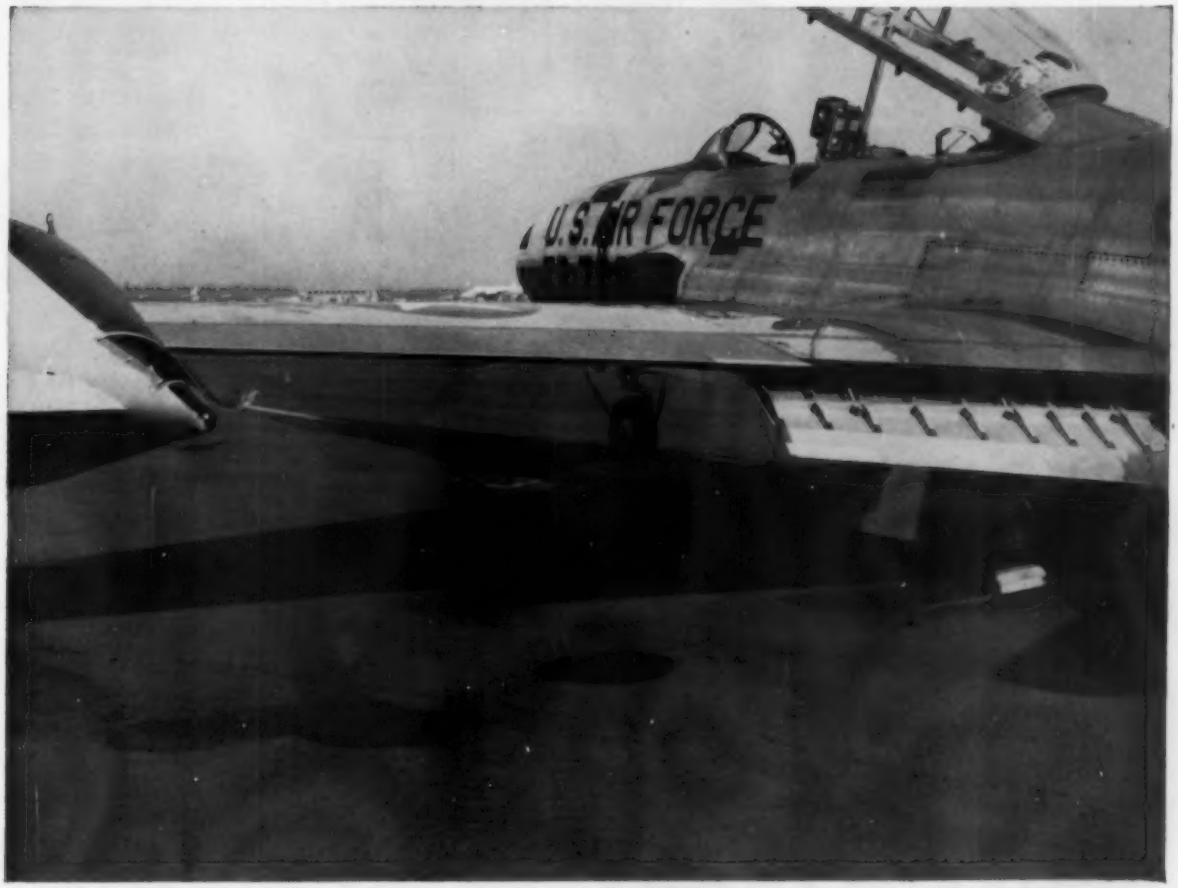
FREE overnight
PARKING
(while space is available)
FOR REGISTERED GUESTS
IN DOWNTOWN
DETROIT

special **FAMILY RATES**
No Charge for Children 12 and Under

In the center of all downtown activities. Newly decorated. Ultra modern, comfortable guest rooms. Excellent food at moderate prices in our modern coffee shop and cafeteria.
Radio, Television Room Available.
Air Conditioned rooms in season.

800 ROOMS
WITH BATH
from **$4**

Hotel
TULLER
FACING GRAND CIRCUS PARK
DETROIT, MICHIGAN
Harry E. Paulsen, Gen. Mgr.



Fuel-resistant Koppers Pavement Sealer ends ramp problem at Scott Air Force Base

The jet age has posed a serious pavement maintenance problem for modern airports: Asphalt ramp surfaces, used for refueling and service work, are extremely vulnerable to deterioration from the solvent action of high grade jet fuel and lubricants.

Scott Air Force Base, located at Belleville, Illinois, has encountered this problem—compounded by mechanical damage from the pivoting and turning movements of jet wheels over the softened pavement.

Maintenance engineers at Scott AFB supervised the application of Koppers Pavement Sealer to give these surfaces a permanent, fuel-resistant cover. Before application of the Sealer, all cracks were repaired, softened areas were cut out and patched, and all surfaces were cleaned with a detergent solution. Two separate coats of Pavement Sealer were applied—13,000 gallons in all—with an appropriate mixture of sand to provide a long-wearing, non-skid surface.

Numerous other air bases and airports have used Koppers Pavement Sealer to protect their service areas and runways against deterioration from petroleum spillage. Koppers Pavement Sealer meets all Federal specifications and Air Force requirements.

For more information on how Pavement Sealer can help you solve your pavement maintenance problems, write Koppers Company, Inc., Pittsburgh 19, Pa., or send the coupon. District Offices: Chicago, Los Angeles, Pittsburgh, New York and Woodward, Alabama. In Canada: Koppers Products, Ltd., Toronto, Ontario.

KOPPERS

KOPPERS

SUPER PAVEMENT SEALER

another fine product of COAL TAR

Koppers Company, Inc.
Tar Products Division
Dept. 138E
Pittsburgh 19, Pa.

I'd like more information on Koppers Pavement Sealer for
☐ Airports ☐ Resealing Asphalt Pavements elsewhere

Name_____

Firm_____

Address_____

City_____ Zone_____ State_____

● **LIGHTWEIGHT "Carry Barrels" can be handled conveniently on either the hip or shoulder. All collection workers in New Rochelle now use these refuse barrels.**

PLASTIC BARRELS SAVE MONEY ON REFUSE COLLECTION

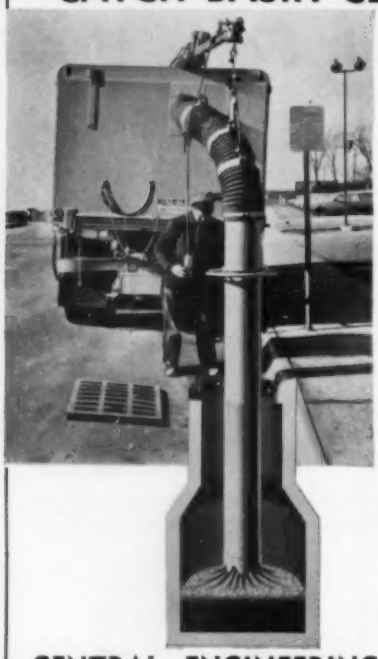
E. H. FELDMAN
Supervisor of Public Works,
New Rochelle, N. Y.

THE Sanitation Department of New Rochelle, N.Y., a city of 80,000 population, has made a change in refuse collection operations which will save the department approximately $50,000 a year.

The city provides residential collection of combined refuse from the rear of the premises twice a week. Formerly, in common with many large cities, the so-called set-out system was used. The truck crew, consisting of a chauffeur and two loaders, is preceded by a set-out crew of two men who bring the full pails from the rear of the property to the curb and is followed by a set-back crew, also of two men, who return the pails to the rear after collection. New Rochelle used nine of these seven-man teams.

A common practice in smaller villages is to collect at the rear of the property by transferring the refuse into an empty container which the collector carries with him, thus avoiding the return trip with the empty pails. Our department studied this system in two neighboring villages. The outstanding problem seemed to revolve around a suitable container to be carried by the collector. Various makeshift containers have been used. Since these villages render three collec-

VAC-ALL
CATCH BASIN CLEANER



AND
YEAR AROUND STREET AND HIGHWAY CLEANER
ONE MAN OPERATION
CLEANS 11 FT. DEEP BASINS IN A FEW MINUTES
EFFORTLESS OPERATION WITH POWER BOOM
PUSH BUTTON REMOTE CONTROL
OPERATION FROM EITHER SIDE OR REAR OF BODY
WRITE FOR BULLETIN V-2

CENTRAL ENGINEERING CO., INC.
4429 W. State St. Milwaukee 8, Wis.

Sewerage and Sewage Treatment
By W. A. HARDENBERGH
Editor, Public Works Magazine; formerly Chief, Sanitary Corps, U. S. Army

A Useful Book For Your Engineering Library
Only $7.25

AN authoritative yet simple treatment of the subject by one of the nation's foremost authorities. Mr. Hardenbergh's editorial and field work have brought him in close contact with the problems that trouble the average engineer. And in this book he explains those methods most suitable for handling the work. Special attention is paid to sewerage systems, both storm and sanitary.

Design examples of all kinds are worked out in detail to illustrate practical, up-to-date methods.

467 pages, liberally illustrated.

Priced at $7.25 a copy, postpaid, this book is being sold under our regular money-back-if-not-satisfied guarantee. Mail your remittance with your order and if not *more than satisfied* with this edition, you may return it within 10 days for full refund.

PUBLIC WORKS Magazine
200 South Broad St., Ridgewood, N. J.

Superior Design, Construction and PERFORMANCE

far greater strength and SAFETY!

AMERICAN Approved

PLAYGROUND AND SWIMMING POOL EQUIPMENT

The wise choice of experienced buyers for nearly half a century.

WRITE FOR LITERATURE

AMERICAN PLAYGROUND DEVICE CO.
ANDERSON, INDIANA, U.S.A.
WORLD'S LARGEST MANUFACTURERS OF FINE PARK, PICNIC, PLAYGROUND, SWIMMING POOL AND DRESSING ROOM EQUIPMENT

HOTTEST STREET PATCHER IN TOWN

the Original HEATED Asphalt Roller

5 TON COMPACTION WATER-TIGHT SEAL

OVER 300 CITIES REPORT, Hot Roll is "the major advancement in recent years for asphalt street repair".

WRITE FOR A DEMONSTRATION TODAY

Ellis Distributing Company
Liberty, Missouri

tions per week the volume at each house was less than in New Rochelle; moreover these villages do not have large congested areas with multiple dwellings such as are found in our city.

In the spring of 1960 the department tested the "Carry Barrel" which is a 55-gallon plastic refuse collection barrel weighing only seven pounds. The Sanitation Department obtained five of these barrels and one route was chosen for the experiment. The set-out men and set-back men as well as the loaders were given barrels. However, one man less was used, making a total of six instead of seven men. Generally speaking, after preliminary apprehension, the men seemed reasonably favorable to the new system. An additional thirty barrels were obtained and the method was tried on a larger scale to determine what "bugs" might develop since new problems are not always foreseeable in an operation of this sort.

During the early phases it became evident that there were many possible benefits, the most important being the saving of manpower, which from the beginning amounted to one man from each crew of seven. The secondary benefit was the reduction of complaints, resulting from the fact that in the new system the pails do not leave the rear of the property.

By May, 1960, enough barrels had been provided so that all refuse routes were using the new system with the set-out and set-back operations entirely eliminated. Also, by this time, the men were familiar with the system and a second man was removed from each of the nine crews. It was necessary at this time to create a tenth crew largely to accommodate growth of the city. Nevertheless, a saving of thirteen men was effected, amounting to about $50,000 a year. Most of the excess manpower was transferred to other Public Works bureaus which were shorthanded. It was not necessary to lay off any annual personnel.

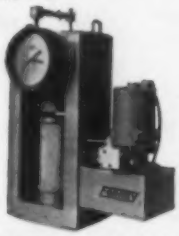
Improved Appearance

Formerly, full and empty refuse pails appeared on the streets on collection days since an hour usually elapsed between setting out and collection and setting back. This resulted in an unsightly appearance of the streets, litter due to wind, animals upsetting pails and empty pails blowing around the streets on windy days. In the new system, the garbage pail never leaves the rear of the

(*Please turn to page* 190)

FORNEY CONCRETE TESTERS

meet the exacting requirements of the construction industry's concrete testing applications.
Forney engineers are proven specialists in the concrete testing equipment field. For eleven years they have furnished the industry with quality testing equipment, accessories and supplies.



MODEL FT-30 HEAVY-DUTY PORTABLE CONCRETE TESTER

Latest addition to a complete line of portables, the FT-30 brings laboratory performance right to the job site. Self-contained power unit eliminates cumbersome hose and manual pumps. Loading speed is completely variable for accurate conformance to current ASTM standards.

MODEL FT-10 "JOBSITER"

LOWEST PRICED TESTER WITH HIGH PRICED FEATURES

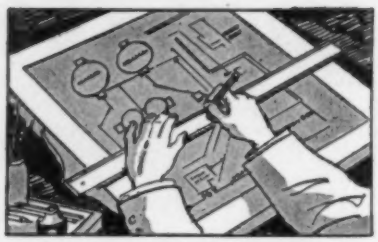
√ 250,000 Lb. Load Rating
√ Designed to Protect Operator From Flying Fragments
√ Fully Protected Gauges Equipped With Instant Connectors

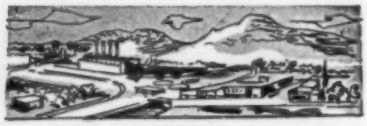
ALL FORNEY EQUIPMENT UNCONDITIONALLY GUARANTEED

KNOWN THE WORLD OVER

FORNEY'S, INC.
Tester Division
P. O. Box 310
New Castle, Pa., U. S. A.
Phone OLiver 2-6611
Cable : Forney's, New Castle

CONSULTING ENGINEERS





CITY, COUNTY AND STATE

ALSTER & ASSOCIATES, INC.
ENGINEERS

PHOTOGRAMMETRIC ENGINEERING •
TOPOGRAPHIC & PLANIMETRIC MAPS •
AERIAL MOSAICS • PRECISE FIELD SURVEYS

6135 Kansas Ave., N.E. • TA 9-1167 • Washington 11, D. C.

Brockway, Weber & Brockway
ENGINEERS INCORPORATED
Land Planning, Civil, Structural,
Municipal and Electrical Engineering
Reports, Plans, Specifications &
Supervision

Home Office
West Palm Beach, Fla.

Branch Office
Ft. Pierce, Fla.

F B&D

Ford, Bacon & Davis
Engineers
ESTABLISHED 1894
Water, Sewage and Industrial Waste Problems
Investigations · Reports for Financing
Design · Supervision of Construction
NEW YORK · CHICAGO · SAN FRANCISCO · MONROE, LA.

GIBBS & HILL, Inc.
Consulting Engineers

Industrial Wastes	Electric Transmission & Distribution Systems	Airports
Water & Sewage Works	Convention & Nuclear Power Generation	Rapid Transit
Hydraulic Developments	Power & Surveys & Contracts	Highways & Bridges

PENNSYLVANIA STATION NEW YORK 1, N.Y.

JOHN McNAIR
WAYNESBORO, VA.

M. T. DECKER
CHARLOTTESVILLE, VA.

AND ASSOCIATES

CONSULTING CIVIL ENGINEERS
STUDIES, REPORTS, DESIGN, CONSTRUCTION SUPERVISION,
HIGHWAYS, AIRPORTS, UTILITIES
COMMUNITY FACILITIES

ROBERT AND COMPANY ASSOCIATES
Municipal Engineering Division
ATLANTA
WATER SUPPLY, SEWAGE DISPOSAL, INCINERATORS, POWER PLANTS

FOSTER D. SNELL, INC.
Consulting Chemists — Chemical Engineering
Mitigation of Fire, Safety Hazards—Evaluation of Architectural & Decorative Materials
Slipperiness of Floors—Fuels & Lubricants—Biology & Toxicology
29 West 15th Street New York 11, New York WAtkins 4-8800 (Direct Dialing Area 212)
Baltimore, Maryland Bainbridge, New York
Member: American Council of Independent Laboratories

Abrams Aerial Survey Corporation
Photogrammetric Services
AERIAL PHOTOGRAPHY,
TOPOGRAPHIC MAPS,
ATLAS SHEETS AND MOSIACS
IVanhoe 4-9441 Lansing, Michigan

AERO SERVICE CORPORATION
Aerial topographic maps — photo-maps or engineering projects anywhere in the world — highways, railroads, cities, power and pipe lines, mining development. Soil studies and electronic surveys of large areas; resources inventories.
210 E. Courtland Philadelphia 20

ALBRIGHT & FRIEL INC.
Consulting Engineers
Water, Sewage, Industrial Wastes and Incineration Problems
City Planning Highways, Bridges and Airports
Dams, Flood Control, Industrial Buildings
Investigations, Reports, Appraisals and Rates
THREE PENN CENTER PLAZA
PHILADELPHIA 2, PENNSYLVANIA

ALVORD, BURDICK & HOWSON
Engineers
Water Works, Water Purification, Flood Relief, Sewage, Sewage Disposal, Drainage, Appraisals, Power Generation
20 No. Wacker Dr. Chicago 6, Ill.

AMERICAN AIR SURVEYS, INC.
Aerial Topo Maps
Aerial Photos & Mosaics
Plan & Profile
Tax Maps
907 PENN AVE., PITTSBURGH 22, PENNA.
BRANCHES: MANHASSET, N.Y. • ATLANTA, GA.
A Nationwide Service

MICHAEL BAKER, JR., INC.
Consulting Engineers, Planners & Surveyors
Airport, Highway & Bridge Design; Water & Sewerage
Municipal Engineering; Photo Mapping
City Planning, Urban Renewal & Redevelopment
Soils Lab; Complete Survey Service
HOME OFFICE—ROCHESTER, PA.
Baker Bldg., P. O. Box 111

JACKSON, MISS.	CHARLESTON, W. VA.	HARRISBURG, PA.
Northview Drive	19 Dunbar Street	2790 N. Fourth St.
P. O. Box 9997	P. O. Box 2148	P. O. Box 790

BANISTER ENGINEERING CO.
Consulting Engineers
"Staffed to completely fill municipal requirements for professional service"
310 No. Snelling Ave. Tel. Midway 6-2612
St. Paul 4, Minnesota

BARNARD AND BURK

Consulting Engineers

Municipal and Industrial Engineering Surveys, Reports, Waterworks, Sewerage and Sewage Disposal, Revenue Projects, Natural Gas, Light and Power, Streets and Highways, Harbor and Port Developments

1023 Nicholson Drive
Baton Rouge, Louisiana

E. D. BARSTOW & ASSOCIATES

Engineers

Water Supply, Treatment, Distribution
Sewage Collection, Treatment, Disposal
Trade Waste Treatment

163 N. Union St. **Akron 4, Ohio**

HOWARD K. BELL

Consulting Engineers, Inc.

Water Works — Swimming Pools
Industrial Wastes — Garbage Disposal
Sewerage — Drainage
Valuations — Rates — Reports
Operation Supervision

553 S. Limestone St. **Lexington, Ky.**

BENHAM ENGINEERING COMPANY

Consulting Engineers

215 NE 23rd Oklahoma City

Established 1909

Black, Crow and Eidsness, Inc.

Engineers

Water, sewerage, power hydrology, recalcination, waste treatment, valuation, special investigations and reports, laboratory services.

700 S.E. Third Street **74 Orchid Square**
Gainesville, Florida **Boca Raton, Florida**

BLACK & VEATCH

Consulting Engineers

Water—Sewage—Gas—Electricity—Industry
Reports, Design, Supervision of Construction
Investigations, Valuations and Rates

1500 Meadow Lake Pkwy., Kansas City 14, Mo.

Bonham, Kuck, Grant and Brundage

H. E. BONHAM — NYE GRANT
CARL E. KUCK — J. M. BRUNDAGE

Consulting Engineers

Sewage and Industrial Waste Treatment
Water Supply and Purification

4954-58 N. High St. **Columbus 14, Ohio**

CLINTON BOGERT ENGINEERS

Consultants

Clinton L. Bogert — Ivan L. Bogert
Donald M. Ditmars — Robert A. Lincoln
Charles A. Manganaro — William Martin

Water & Sewage Works — Incinerators
Drainage — Flood Control
Highways and Bridges — Airfields

145 East 32nd Street, New York 16, N.Y.

BOWE, ALBERTSON & ASSOCIATES

Engineers

Water and Sewage Works
Industrial Wastes
Refuse Disposal
Valuations
Laboratory Service

75 West St. **1000 Farmington Ave.**
New York 6, N.Y. **West Hartford 7, Conn.**

BOYLE ENGINEERING

Architectural & Engineering Consultants

Water—Development, Treatment, Storage, Distribution. Sewage Collection. Sewage Treatment. Refuse.
Waste Disposal—Industrial, Commercial, Residential, Municipal, Highways, Streets, Bridges, Parks, Harbors, Flood Control, Special Districts, Civic, Industrial, Commercial Buildings, Structures, Site Planning.

Bakersfield **Santa Ana** **San Diego**
California

Floyd G. Browne and Associates

Consulting Engineers

F. G. Browne — S. W. Kuhner
W. G. Smiley — G. M. Hinkamp
C. R. Martin — W. H. Kuhn

Water Supply and Purification — Sewage and Industrial Waste Treatment — Refuse Disposal — Electric Systems — Surveys — Reports Valuation and Rates

Marion, Ohio

FOR RATES FOR THIS SPACE

write

PUBLIC WORKS MAGAZINE

200 So. Broad St. **Ridgewood, N.J.**

BROWN ENGINEERING CO.

Consulting Engineers

Waterworks, Sewage Disposal, Airports
Street Improvements, Power Plants
Electric Distribution, Rates

508 TENTH STREET **DES MOINES 9, IOWA**

BUCK, SEIFERT AND JOST

Consulting Engineers

Water Supply — Sewage Disposal
Hydraulic Developments
Reports, Investigations, Valuations
Rates, Design, Consultation, Operation
Management, Chemical and
Biological Laboratories

112 East 19th St. **New York City**

BURGESS & NIPLE

Consulting Engineers

Established 1908

Water supply, treatment and distribution
Sewage and industrial wastes disposal
Investigations, reports, appraisals, rates
Airports, Municipal Engineering, Supervision

2015 West Fifth Ave. **Columbus 12, Ohio**

RALPH H. BURKE, INC.

Consulting Engineers

Traffic Studies — Underground Garages
Parking Structures — Grade Separations
Expressways, Airports and Terminal Buildings
Shore Protection — Municipal Engineering
Parks — Field Houses — Swimming Pools

20 North Wacker Drive, Chicago 6, Ill.

BURNS & McDONNELL

Engineers - Architects - Consultants

4600 E. 63rd ST., TRAFFICWAY
KANSAS CITY 41, MISSOURI

J. W. BURT

Civil Engineer and Designer

Specializing in

ROADS AND BRIDGES
PHONE 1701 **P.O. BOX 381**
McCOMB, MISSISSIPPI

CAMP, DRESSER & McKEE

Consulting Engineers

Water Works and Water Treatment
Sewerage and Sewage Treatment
Municipal and Industrial Wastes
Investigations and Reports
Design and Supervision
Research and Development
Flood Control

18 Tremont Street **Boston 8, Mass.**

Capitol Enginering Corporation

Consulting Civil Engineers

Dillsburg, Pennsylvania, U.S.A.

JOHN A. CAROLLO

Consulting Engineers

Water Supply and Purification, Sewage
Sewage Treatment, Power Generation and
Distribution, Gas Systems, Valuations

3308 N. Third St., Phoenix, Arizona
2168 Shattuck Ave., Berkeley 4, Calif.

HOMER L. CHASTAIN & ASSOCIATES

Consulting Engineers

Civil, Structural, Mechanical, Industrial Design & Supervision, Construction, Engineering, Turnpikes, Bridges, Water Supply, Sewerage, Flood Control & Drainage, Material Controls, Municipal Engineering, Topographic Surveys.

155½ West Main Street **Decatur, Illinois**

THE CHESTER ENGINEERS

Water Supply and Purification
Sewage and Industrial Waste Treatment
Power Plants—Incineration—Gas Systems
Valuations—Rates—Management
Laboratory—City Planning

601 Suisman Street, Pittsburgh 12, Penna.

CHICAGO AERIAL SURVEY

PHOTOGRAMMETRIC ENGINEERS

Aerial photography since 1923. Complete photogrammetric services for city, county, highway and consulting engineers.
Developers of Bonne Strip Photography
• Base maps and atlas sheets • Precise topographic maps for sewerage studies, construction planning and site location • Scaled mosaics and pictorial presentations • Highway studies. Street and road maps. Bonne photography.

10265 FRANKLIN AVE., FRANKLIN PARK, ILL.
A Division of Chicago Aerial Industries, Inc.

FOR RATES FOR THIS SPACE

WRITE

PUBLIC WORKS MAGAZINE

200 So. Broad St., Ridgewood, N.J.

CLARK, DAILY AND DIETZ

Consulting Engineers

Sewerage, Waterworks, Street Lighting, Highways, Swimming Pools, Surveying and Mapping, Land Development Studies, Bridges, Buildings, Foundations.

211 North Race St. **188 Jefferson St.**
Urbana, Illinois **Memphis, Tennessee**

CLARK & GROFF ENGINEERS

Consulting Engineers

Civil, Sanitary & Municipal Engineering
Investigations Reports, Plans
Supervision of Construction
Laboratory

3240 Triangle Dr. **Salem, Oregon**

CHAS W. COLE & SON

Engineers—Architects

3600 E. Jefferson Blvd. South Bend, Indiana
2112 W. Jefferson St. Joliet, Illinois

CONSOER, TOWNSEND & ASSOC.
—CONSULTING ENGINEERS—

Sewerage treatment, sewers, storm drainage, flood control—water supply and treatment—Highway and bridges—Airports—Urban renewal—Electric and gas transmission lines—Rates studies, surveys and valuation—Industrial and institutional buildings.

360 EAST GRAND AVENUE
CHICAGO 11, ILLINOIS

CRAWFORD, MURPHY & TILLY

Consulting Engineers

Water Works—Impounding Reservoirs
Highways—Municipal Streets—Expressways
Traffic Problems—Airports—Swimming Pools
Sewers—Sewage Treatment—Wastes Treatment
Storm Drainage—Flood Control—Surveys & Reports

735 So. Grand Ave., W. Springfield, Ill. Lakeside 8-5619

ALFRED CREW

Consulting Engineers

Water Supply, Treatment and Distribution
Sewerage and Sewage Disposal
Drainage and Industrial Wastes

45 N. Broad St. Ridgewood, N.J.

FOR RATES FOR THIS SPACE

write

PUBLIC WORKS MAGAZINE

200 So. Broad St. Ridgewood, N.J.

Consulting Engineers

DE LEUW, CATHER & COMPANY

Public Transit
Traffic & Parking
Expressways
Grade Separations
Urban Renewal
Subways
Railroad Facilities
Industrial Plants
Municipal Works
Port Development

150 North Wacker Drive, Chicago 6
San Francisco New York Toronto Boston

H. G. DILL COMPANY

Consulting Engineers

H. G. Dill
B. W. Lipes
H. J. Roberts
G. W. Hockaden
J. A. Rousculp
P. Priede

Civil, Sanitary, Structural, Municipal, Highway, Subdivision, Planning, Property Surveys, Topographic Surveys, Reports, Appraisals.

2607½ No. High St. Columbus 2, Ohio
AM 2-9744

NORMAN O. ELDRED

Consulting Engineer

Water Supply and Distribution Systems, Municipal and Industrial Water Conditioning Equipment, Steam Power Plants, Diesel-Electric Power Plants, Electric Systems, Street Lighting, Pavements, Airports, Drainage, Sewage Treatment, Trade Wastes Disposal, Municipal Incinerators, Industrial Plant Designs, Propane & Butane Storage & Vaporizer Plants.

P.O. Box 3396 Merchandise Mart Postal Sta.
Chicago 54, Illinois

FOR RATES FOR THIS SPACE

write

PUBLIC WORKS MAGAZINE

200 So. Broad St. Ridgewood, N.J.

FAY, SPOFFORD & THORNDIKE, INC.

Engineers

Airports—Bridges—Express Highways
Industrial Bldgs.—Incinerators—Port Developments
Water Supply—Drainage and Sewerage Systems

11 Beacon Street, Boston, Mass.

FINKBEINER, PETTIS & STROUT

Consulting Engineers

Water Supply, Water Treatment,
Sewerage, Sewage Treatment,
Bridges, Highways & Expressways

2130 Madison Avenue Toledo 2, Ohio

WALTER H. FLOOD & CO.

Chemical Engineers

Inspection and Testing of Materials and Structures
Streets—Roads—Airports
Building and General Engineering Construction
Resident Inspection—Chemical & Physical Tests
Soil Boring & Investigation—Concrete Core Cutting
Specifications—Reports—Research

6102 S. Blackstone Ave. Chicago 37, Ill.

FRIDY, GAUKER, TRUSCOTT & FRIDY, INC.

Engineers

Hospitals, Schools, Industrial Buildings, Public Buildings, Airports, Roads, Water, Sewage, Petroleum Facilities, Waste Disposal, Power & Lighting, Reports, Plans, Supervision, Appraisals.

1321 Arch Street Philadelphia 7, Penna.

M. E. FRYE & ASSOCIATES, INC.

CONSULTING ENGINEERS

Investigations • Reports
Civil, Sanitary & Municipal Engineering
Planning • Designs • Supervision

428 Blvd. of Allies
Pittsburgh 19, Pa.
EXpress 1-0818
166 E. Union St.
Somerset, Pa.
SOmerset 6366

GILBERT ASSOCIATES, Inc.

Engineers and Consultants

Power Plant Engineering
Water Supply and Purification
Sewage and Industrial aste Treatment
Chemical Laboratory Service

New York READING, PA. Washington

GOODKIND & O'DEA

Consulting Engineers

Foundations, Structures, Highways,
Sewerage, Water Supply, Drainage

610 Bloomfield Ave., Bloomfield, N.J.
New York, N.Y. Hamden, Conn. Chicago, Ill.

GREELEY & HANSEN

Engineers

Water Supply, Water Purification
Sewerage, Sewage Treatment
Flood Control, Drainage, Refuse Disposal

14 East Jackson Blvd., Chicago 4, Illinois

HOWARD R. GREEN CO.

Consulting Engineers

DESIGN AND SUPERVISION OF MUNICIPAL DEVELOPMENTS
Water Works and Treatment—Sewers and Sewage Disposal—Investigations and Valuations

208-10 Bever Bldg., Cedar Rapids, Iowa
Established 1913

Plastic Barrels

(*Continued from page* 187)

property and these problems and complaints have disappeared.

Now that the entire crew does the same work, the load is more evenly distributed. The operation is easier to manage since all the men in the crew now work in the vicinity of the truck. Previously the set-out men would start work at 5:30 a.m., an hour before the collection crew. Both the set-out and set-back men had to bring themselves onto the route in their own cars. These undesirable practices are obviated.

Of the several types of collection containers tried, the plastic barrels seem to be the most acceptable to the collectors and to give the longest life. This wide, low barrel, made by County Chemical Company, Bellmore, L. I., N. Y., weighs only 7 lbs. in the 55-gal. size. Now under test is a new 5½-lb. barrel of the same shape.

• • •

New Dam and Reservoir for EBMUD

The contract for construction of Briones Dam, the largest single water development project ever undertaken in the California East Bay area, has been awarded by the East Bay Municipal Utility District to Guy F. Atkinson Company of South San Francisco. The bid price was $13,888,094. At the same time, EBMUD awarded the contract for construction of the 90-inch diameter Briones Aqueduct, an integral part of the dam project, to B. J. Ukropina, T. P. Polich and Sons, Steve Kral Corp. and Vinnell Corp., a joint venture. The cost will be $549,205.

Briones dam will be built at the west end of Briones Valley. It will take three years to build the dam and another 30 to 36 months to fill the 22-billion gallon reservoir, which will inundate 725 acres. The total watershed area will cover more than 8½ square miles.

Briones will be an earthfill dam, 270 feet high above the bed of Bear Creek and will have a crest length of 2,100 feet. Width at the base will be 1,520 feet. Crest width will be 50 feet. Approximately 10 million cubic yards of earth will go into the embankment.

According to EBMUD engineers, Briones water can be supplied to the Orinda control works at a rate of 336 million gallons a day. By comparison, the present average daily consumption in the entire East

WILLIAM F. GUYTON AND ASSOCIATES

Consulting Ground-Water Hydrologists

Underground Water Supplies
Investigations, Reports, Advice

307 W. 12th St., Austin 1, Texas
Phone: GR 7-7165

GWIN ENGINEERS, INC.

Consulting Engineers

Highways — Water Supply
Municipal — Sewage Disposal
Planning — Mapping

Reports, Design, Supervision of Construction, Surveys

1200 12th Ave. — Altoona, Pa.

HARDESTY & HANOVER

Consulting Engineers

Long Span and Movable Bridges, Hanover Skew Bascule, Grade Eliminations, Foundations, Expressways and Thruways, Other Structures, Supervision, Appraisals, and Reports

101 Park Avenue, New York 17, N.Y.

HAVENS AND EMERSON

A. A. Burger — H. H. Moseley
J. W. Avery — F. S. Palocsay
E. S. Ordway — G. H. Abplanalp
A. M. Mock — S. H. Sutton
Frank C. Tolles, Consultant

Consulting Engineers

Water, Sewerage, Garbage, Industrial Wastes, Valuations—Laboratories

Leader Bldg., Cleveland 14, O. — Woolworth Bldg., New York 7, N.Y.

HAZEN AND SAWYER

Engineers

Richard Hazen — Alfred W. Sawyer
H. E. Hudson, Jr

Water and Sewage Works
Industrial Waste Disposal
Drainage and Flood Control

360 Lexington Ave., New York 17, N.Y.

HENNINGSON, DURHAM & RICHARDSON, INC.

Consulting Engineers

Consulting Engineers since 1917 for more than 700 cities and towns
Water Works, Light and Power, Sewerage, Paving, Airports, Reports, Appraisals, Drainage

2962 Harney St. — Omaha 2, Nebr.

HILL & HILL Engineers

Sewage and Waste Disposal,
Water Supply and Filtration,
Dams, Reservoirs, Tunnels,
Airport and Topographic Surveys

Home Office: 8 Gibson St., North East, Pa.

HAROLD HOSKINS & ASSOCIATES

Consulting Engineers

Sewers and Sewage Treatment
Paving — Water Supply — Drainage
Bridges — Airports — Reports
Aerial Photogrammetry
Power Plants — Surveys

1630 Que St., Lincoln 8, Nebr.
1018 Eight Avenue, Greeley, Colorado

MARK HURD AERIAL SURVEYS, INC.

Topographic And Planimetric Maps
Tax Maps — Aerial Photography

345 Pennsylvania Avenue South
Minneapolis 26, Minnesota

Jenkins, Merchant & Nankivil

Consulting Engineers

Municipal Improvements — Gas Systems
Highways & Airports — Water Systems
Power Development — Sewerage Systems
Traffic Surveys — Industrial Plants
Flood Control — Recreational Facilities
Investigations and Reports

801-805 East Miller St., Springfield, Ill.

JOHNSON DEPP & QUISENBERY Inc.

Consulting Engineers

Highways — Water Supply
Airports — Sewage Disposal
Planning — Surveys

2625 Frederica St. — Owensboro, Ky.

JOHNSON SOILS ENGINEERING LABORATORY

Laboratory and Field Testing
Shear and Consolidation Tests
Design and Construction Control

MOBILE LABORATORIES

193 West Shore Avenue
Bogota, New Jersey

JONES HENRY & WILLIAMS

Consulting Sanitary Engineers

Water Works
Sewerage and Treatment
Waste Disposal

2000 West Central Avenue — Toledo 6, Ohio

EDWARD C. JORDAN CO., INC.

Civil & Sanitary Engineers

Sewerage • Sewage Disposal • Industrial Wastes
Drainage • Water Supply • Streets • Highways
Municipal Engineering
Investigations—Reports—Designs—Supervision

379½ Congress St., Portland, Maine
Tel. SP 4-0315

KENNEDY ENGINEERS

Complete Public Works Engineering

- Water Supply
- Sewage and Waste Treatment
- Sewage Reclamation
- Utilities Planning

CHEMICAL and BIOLOGICAL LABORATORY
SAN FRANCISCO

Los Angeles — Tacoma — Salt Lake City

KEIS & HOLROYD

Consulting Engineers

(Formerly Solomon & Keis)
Since 1906

Water Supply, Sewage Disposal, Garbage & Refuse Incineration, Industrial Buildings

Troy, N.Y.

FENTON G. KEYES ASSOCIATES

Consulting
ARCHITECT-ENGINEERS

Providence 3, R.I. — Waltham 54, Mass.

KOEBIG & KOEBIG, INC.

ENGINEERING — ARCHITECTURE
MUNICIPAL PLANNING

Reports Investigations Designs
Consultants to Cities Since 1910

3242 W. 8th Street, Los Angeles 5, California
715 Bank of America Building,
625 Broadway, San Diego, California

MORRIS KNOWLES INC.

Engineers

Water Supply and Purification, Sewage and Sewerage Disposal, Industrial Waste, Valuations, Laboratory, City Planning

1312 Park Building, Pittsburgh 22, Pa.

KREHBIEL & KREHBIEL • engineers

Consulting

DRAINAGE — REPORTS
HIGHWAYS — SEWERAGE
ICE RINKS — SUBDIVISIONS
PLANNING — SURVEYS
POOLS — WATER

1868 NIAGARA FALLS BOULEVARD • TONAWANDA, N. Y.

LADD ENGINEERING CO.

Consulting Engineers

Sewers, Water, Paving,
Filter Plants, Disposal Plants,
Electric Systems

Southeastern States

Home Office: FORT PAYNE, ALA.

LORENZI, DODDS and GUNNILL

Berger Building
Pittsburgh 19, Pennsylvania

Consulting Engineers

Serving
Pennsylvania, Ohio and West Virginia

LOZIER CONSULTANTS, INC.

Engineers

Sewerage, Sewage Disposal, Water Supply, Water Purification, Refuse Disposal

10 Gibbs Street — Rochester 4, N.Y.

McCREARY • KORETSKY • ENGINEERS

MKE

PLANNING-DESIGN-REPORTS
FOR
MUNICIPAL FACILITIES

1140 Howard Street, San Francisco, Calif. — 5675 Freeport Blvd., Sacramento, Calif.

FOR RATES FOR THIS SPACE

write

PUBLIC WORKS MAGAZINE

200 So. Broad St. — Ridgewood, N.J.

MADDOX AND HOPKINS

Engineers and Surveyors

Highways, Utilities, Structures
Topographic Maps — Photogrammetry
Plane and Geodetic Surveys

8506 Dixon Ave. — Silver Spring, Md.

GEORGE B. MEBUS, INC.

Consulting Engineers

Sewerage — Industrial Wastes
Water Supply — City Planning
Investigations and Reports
Design and Supervision of Construction
Valuations

Broad Street Trust Co., Bldg.
Glenside, Pa.

MERRITT & WELKER
Engineers
Water, Sewage, Streets, Roads, Natural Gas, Valuations, Municipal Planning
208 Roswell Street Marietta, Georgia

METCALF & EDDY
Engineers
Soils, Foundations, Waterworks, Sewage Works, Drainage, Irrigation, Flood Control, Refuse, Industrial Wastes, Airports, Highways, Military Projects, Industrial and Commercial Facilities.
Statler Building, Boston 16, Massachusetts

MORAN, PROCTOR, MUESER & RUTLEDGE
Consulting Engineers
Foundations for Buildings, Bridges and Dams; Tunnels, Bulkheads, Marine Structures; Soil Studies and and Tests, Reports, Design and Supervision
415 Madison Ave. New York 17, N.Y.
ELdorado 5-4800

FOR RATES FOR THIS SPACE
write
PUBLIC WORKS MAGAZINE
200 So. Broad St. Ridgewood, N.J.

NUSSBAUMER-CLARKE and VELZY
Consulting Engineers
Sewage Treatment—Water Supply
Incineration—Drainage—Highway Planning
Appraisals and Rate Studies
327 Franklin St., Buffalo 2, N.Y.
500—5th Ave., New York 36, N.Y.

O'BRIEN & GERE
Consulting Engineers
Water Supply, Treatment, and Distribution
Sewerage and Sewage Treatment
Industrial Waste Treatment—Flood Control and Drainage
Rates Studies—Development Planning—Surveys
400 East Genesee Street Syracuse 2, N.Y.

PARSONS, BRINCKERHOFF QUADE & DOUGLAS
Civil & Sanitary Engineers
Water, Sewage, Drainage and Industrial Waste Problems, Structures—Power—Transportation
165 Broadway New York 6, N.Y.

E. LIONEL PAVLO
Consulting Engineer
Design, Supervision, Reports
Bridges, Highways, Expressways
Marine Structures, Public Works
Industrial Construction, Airports
642 Fifth Ave. New York 19, N.Y.

MALCOLM PIRNIE ENGINEERS
Malcolm Pirnie — Carl A. Armander
Ernest W. Whitlock — Malcolm Pirnie, Jr.
Robert D. Mitchell — Alfred C. Leonard
MUNICIPAL & INDUSTRIAL
Water Supply — Water Treatment
Sewage and Waste Treatment
Drainage — Rates — Refuse Disposal
25 West 43rd St. New York 36, N.Y.
3013 Henetia St. Tampa 9, Florida

THE PITOMETER ASSOCIATES, INC.
Engineers
Water Waste Surveys
Trunk Main Surveys
Water Distribution Studies
Water Measurement and Special Hydraulic Investigations
50 Church St., New York City

PRAEGER-KAVANAGH
Engineers
126 E. 38th St. New York 16, N.Y.

RADER AND ASSOCIATES
Engineers—Architects
Water Works, Sewers, Sewage Disposal and other Public Works Projects, Hotels, Office, Industrial and Commercial Buildings
Plans, Specifications, Supervision, Reports
Investigations, Consultations
Aerial Photography, Photogrammetry
The First National Bank Bldg., Miami 32, Florida
Phone FRanklin 1-3551

ROY EDWIN RAMSEIER AND ASSOCIATES
Sanitary and Hydraulic Engineers
Water Supply, Treatment, Distribution
Sewerage and Sewage Treatment
Chemical and Bacteriological Laboratories
1539 Solano Avenue, Berkeley 7, California

DALE H. REA
Consulting Engineers
Water Supply and Treatment, Sewage Collection and Treatment, Irrigation, Reservoirs and Dams, Airports, Buildings and Bridges
Appraisals — Reports — Specifications
Supervision of Construction
2200 West Chenango Littleton, Colorado
PY. 4-3546

FOR RATES FOR THIS SPACE
write
PUBLIC WORKS MAGAZINE
200 So. Broad St. Ridgewood, N.J.

RIPPLE AND HOWE, Inc.
Consulting Engineers
APPRAISALS AND REPORTS
DESIGN AND SUPERVISION
Water Works Systems, Filtration Plants, Irrigation and Drainage Systems, Reservoirs and Dams, Sanitary and Storm Sewer Systems, Sewage Treatment Plants, and Refuse Disposal.
O. J. Ripple V. A. Vaseen B. V. Howe
2747 Zeni St. Denver 11, Colo.

RUSSELL AND AXON
Consulting Engineers
Civil—Sanitary—Structural
Industrial—Electrical
Rate Investigations
408 Olive St., St. Louis 2, Mo.
Municipal Airport, Daytona Beach, Fla.

CARL SCHNEIDER
Consulting Engineers
Incineration — Sanitary Fills
Refuse Collection — Sanitation Studies
Reports
602 Pan American Bldg.
New Orleans 12, La.

Bay Municipal Utility District is less than 160 million gallons a day, and the most water ever consumed in one day by East Bay homes and factories was 249.5 million gallons on June 2, 1960. However, water consumption in the District is expected to reach 340 million gallons a day by the year 2000.

Briones will be filled with water from EBMUD's Mokelumne aqueducts by Briones Pumping Plant, to be constructed in conjunction with Lafayette Tunnel No. 2. After it is filled, according to EBMUD engineers, 1.1 billion gallons of local runoff annually in the San Pablo watershed will keep the reservoir at full capacity until it becomes operational. The reservoir will also assist in reducing runoff and controlling flood flows in the San Pablo Creek area, thus acting, in a limited manner, as a flood control dam.

European Course in Sanitary Engineering

The European Course in Sanitary Engineering, organized by the Technological University at Delft and the Netherlands Universities Foundation for International Co-operation (NUFFIC) with the Organization for European Economic Co-operation and the WHO, will be held from October 23, 1961 to July 17, 1962.

The course will be of 9 months duration with instruction in the English language. It comprises lectures, practical laboratory courses, group discussions, design exercises, and field trips to sanitary works in Western Europe. Certificates will be awarded. The Faculty will be headed by Prof. W. F. J. M. Krul, professor of sanitary engineering at the Technological University at Delft; L. J. Mostertman, director of studies of the International Course in Hydraulic Engineering, will be charged with the daily direction of the Course. The tuition fee for the Course is 2000 Dutch Guilders (approx. $530). Closing date for applications is July 31st, 1961. Further particulars on application to NUFFIC, 27, Molenstraat, The Hague, The Netherlands.

Kilowatt Hours in Pumping

The Detroit Water Department reports that for the year ending June 30, 1960, 408 kwh were required to raise one million gallons 100 ft. into the distribution system. For the previous year, 406 kwh were required.

IRBY SEAY COMPANY

Engineers—Consultants

Water Supply & Treatment — Natural Gas Systems
Sewage System & Treatment — Electrical

514 Goodwyn Inst. Bldg. Phone JAckson 7-3301
Memphis, Tennessee

SEELYE STEVENSON VALUE & KNECHT

Consulting Engineers

Richard E. Dougherty, Consultant
Civil, Mechanical, Electrical
Airports, Highways, Bridges, Industrial Plants, Dams, Water Supply, Sanitation, Tunnels, Piers, Reinforced Concrete, Steel

101 Park Avenue — New York 17, N.Y.

SERVIS, VAN DOREN & HAZARD

Engineers—Architects

Construction • Appraisals

Investigations • Design • Supervision of Water • Sewage • Streets • Expressways • Highways • Bridges • Foundations • Airports • Flood Control • Drainage • Aerial Surveys • Site Planning • Urban Subdivisions • Industrial Facilities Electrical • Mechanical

2910 Topeka Blvd. — Topeka, Kansas

SMITH & GILLESPIE

Municipal and Consulting Engineers

Water Supply, Water Purification
Sewerage, Sewage Disposal, Drainage
Refuse Disposal, Gas Systems, Power Plants
Airports

Jacksonville — Florida

John R. Snell ENGINEERS Inc.

221 N. Cedar ■ Lansing, Mich. ■ IV 4-9493

Water and Sewage ■ Industrial Wastes ■ Refuse Disposal ■ Highways and Streets ■ Airports and Harbors ■ Bridges and Structures ■ Soils and Foundations ■ Urban Planning ■ Research and Development

SOIL TESTING SERVICES, INC.

Consulting Engineers

CARL A. METZ — JOHN P. GNAEDINGER

Soil Investigations
Foundation Recommendations and Design
Laboratory Testing

1827 No. Harlem Ave. — Chicago 35, Ill.
San Francisco — Milwaukee, Wis.
Havana, Cuba — Portland, Michigan

SPRAGUE & HENWOOD, INC.

Drilling Services

Foundation Investigations — Test Boring
Grout Hole Drilling and Pressure Grouting
Diamond Core Drilling

221 W. Olive St., Scranton, Pa.
New York, Philadelphia, Pittsburgh, Nashville
Grand Junction, Colorado, Tucson
Buchans, Newfoundland

FOR RATES FOR THIS SPACE

Write

PUBLIC WORKS MAGAZINE

200 So. Broad St., Ridgewood, N.J.

STANLEY ENGINEERING COMPANY

Consulting Engineers

Hersey Building — Muscatine, Iowa
208 S. LaSalle St. — Chicago 4, Illinois
1154 Hanna Building — Cleveland 15, Ohio

ROBERT H. STELLWAGEN

Consulting Engineers

Municipal and Industrial Waste Problems
Collection, Incineration, Salvage, Pumping, Treatment, Testing

1442 E. Outer Drive — Detroit 34, Mich.

ALDEN E. STILSON & ASSOCIATES

Consulting Engineers

Water Supply, Sewerage, Industrial Waste
Bridges—Highways—Industrial Structures
Mechanical & Industrial Layouts & Studies
Land Use Planning & Industrial Parks

245 N. High St. — 75 Public Square
Columbus, Ohio — Cleveland, Ohio
54 14th St. — Wheeling, W. Va.

STETSON, STRAUSS & DRESSELHAUS, INC.

Civil & Consulting Engineers

Los Angeles — Oceanside — Porterville

INVESTIGATIONS - REPORTS - DESIGNS - ESTIMATES

Water Supply, Drainage, Sewerage, Municipal Works, Foundations, Materials Testing, Surveying & Mapping.

Main Office: 215 W. 7th St., Los Angeles, Calif.

SUHR, PETERSON, PETERSON & SUHR

Consulting Engineers

REPORTS—PLANS—SUPERVISION

Sewerage, Water Supply, Flood Control and Drainage, Airports, Roads, Surveys, Fixed and Movable Bridges.

130 N. Wells St. — Chicago 6, Illinois

FOR RATES FOR THIS SPACE

write

PUBLIC WORKS MAGAZINE

200 So. Broad St. — Ridgewood, N.J.

WALLACE & HOLLAND

Consulting Engineers

MUNICIPAL	SANITARY	STRUCTURAL
Streets	Pollution Control	Bridges
Airports	Swimming Pools	Buildings
Planning	Storm Drainage	Storage Bins
Expressways	Water Supply	Investigations

401 North Federal Avenue, Mason City, Iowa

JOSEPH S. WARD & ASSOCIATES

Consulting Soil and Foundation Engineer

Site Investigation, Boring Supervision, Laboratory Soils Testing, Foundation and Pavement Analysis and Design, Construction Supervision, Engineering Reports and Consultation.

91 Roseland Avenue — Caldwell, N.J.
Jefferson Bldg. — Philadelphia, Penna.

J. STEPHEN WATKINS

J. S. Watkins — G. B. Watkins

Consulting Engineers

Municipal and Industrial Engineering, Water Supply and Purification, Sewerage and Sewage Treatment, Highways and Structures, Reports, Investigations and Rate Structures.

446 East High Street — Lexington, Kentucky
Branch Office
2617 Dixie Highway — Louisville, Kentucky

FOR RATES FOR THIS SPACE

write

PUBLIC WORKS MAGAZINE

200 So. Broad St. — Ridgewood, N.J.

WELCH AND MALINOFSKY

Consulting Engineers & Geologists

- Soils and Foundations
- Engineering Geology
- Photo-Interpretation

382 Springfield Ave., Summit, N.J.
CRestview 7-1323

ROY F. WESTON, INC.

ENGINEERS—BIOLOGISTS—CHEMISTS

Industrial Wastes—Stream Pollution
Air Pollution—Water Sewage
Surveys—Research—Development—Process Engineering—Plans and Specifications
Operation Supervision—Analyses
Evaluations and Reports

NEWTOWN SQUARE, PA.

WALTER H. WHEELER EM., M. A. S. C. E.

Designing and Consulting Engineer

Buildings, Bridges, Mfg. Plants, Etc.
Inventor "Smooth Ceilings" Flat Slab Construction

802 Met. Life Bldg. — Minneapolis, Minn.
Tel. Federal 3-1019

WHITMAN, REQUARDT and Associates

Civil—Sanitary—Structural
Mechanical—Electrical
Reports, Plans, Supervision, Appraisals

1304 St. Paul St., Baltimore 2, Md.

CLYDE E. WILLIAMS & ASSOCIATES, INC.

Aerial Mapping
Civil & Sanitary Engineering

312 W. Colfax Ave., South Bend 1, Ind.
720 E. 38th St., Indianapolis 5, Ind.

WILSEY, HAM & BLAIR

Engineers & Planners

Water and Sewage Works
Flood Control and Drainage
Utilities Rate and Valuation Studies
Airports, Traffic Studies and Bridges
City and Regional Planning

111 Rollins Road — 800 W. Colorado Blvd.
Millbrae, Calif. — Los Angeles 41, Calif.

WILSON & COMPANY

Engineers

Water, Sewerage, Streets, Highways, Dams, Bridges, Electrical, Airfields, Drainage, Treatment Plants, Industrial Installations.
Chemical Testing Lab—Aerial Mapping
Electronic Computer Services

631 E. CRAWFORD — SALINA, KANSAS

Hudson Worthington Associates Ltd.

Consulting Engineers

Civil — Municipal — Structural

Streets, roads, highways, ordges and interchanges. Industrial, commercial and utility structures. Water, sewage and industrial waste treatment. Foundations, falsework and estimates. Reports and construction supervision.

214 N. MAIN STREET, HUDSON, OHIO

J. C. ZIMMERMAN ENGINEERING CO.

Consulting Engineers

Water Supply and Treatment
Drainage—Flood Relief
Sewerage and Sewage Treatment
Planning Design Supervision

11121 West Oklahoma Avenue
West Allis 19, Wisconsin

PUBLIC WORKS

EQUIPMENT NEWS

Motor Grader

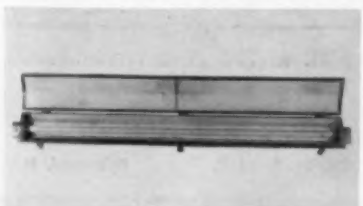
The 105 horsepower 145-T motor grader is a medium weight motor grader with outstanding dependability and maximum job availability. The power plant is the turbocharged 105 horsepower 7000 series engine. It promises fuel economy, easy starting and quick response. Weight of the 145-T is 21,640 pounds. The AC five-model grader line includes the model D and the model DD—both with 58 horsepower; the 80 horsepower model 145; the 105 horsepower model 145-T; and the 127 horsepower model Forty-Five. There is a model for every class and type of user, whether county, state, municipal government or contractor requirement.

Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.

Circle **No. 5-1** on the convenient reply card facing page 34.

Sign Light

Fluorescent sign-lighting luminaires offer a high level of uniform illumination for approximately 30 percent less than the total cost of conventional sign lights. The fixtures can be top or bottom mounted, individually or in continuous rows. They are prewired and preassembled for fast installation. Three lengths of fixtures are available—four, six, or eight feet. Either 800-milliamp or 1500-milliamp high-output lamps can be used. A unit called the Sataliner, one of two models, is recommended for locations where the best possible illumination is needed. The Adliner is a low-cost model of the fluorescent sign lighting fixtures. These fixtures can also be used to light building fronts, dock and loading areas, service stations, underpasses and highway signs.



Westinghouse Lighting Division, Edgewater Park, Cleveland, Ohio.

Circle **No. 5-2** on the convenient reply card facing page 34.

Landscape Seeder

A landscape seeder with the flexibility to provide exact and accurate work on a wide variety of seeding jobs, the John Deere 265, can be used for planting any lawn or cover-grass mixtures, including legume seeds. It has a wide range of seeding settings. It can plant at the light seeding rate of ½ lb/acre for seeds such as red fescue or as high as a 360 lb/acre for grasses such as bermuda or some clovers. It has a similar wide range of performance for spreading fertilizer. The seeder is a thre-point-hitch unit which can be attached to or removed from any three-point-hitch trac'or in minutes. In one operation it finishes a prepared seedbed, applies a six-foot band of seed and fertilizer, and then covers both. It operates at

speeds up to 4½ miles per hour. The machine was designed to meet the requirements of landscapers, park systems, and street and highway building and maintenance departments.

Deere & Co., 3300 River Drive, Moline, Ill.

Circle **No. 5-3** on the convenient reply card facing page 34.

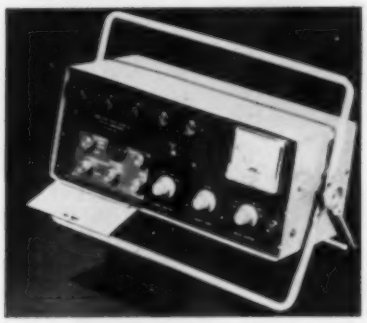
Steam Cleaner

The Malsbary 150, a large capacity steam cleaner, is the same size as the Model 130 it replaces, but pump capacity has been increased to 135-150 gph. The Model 150 retains the orifice and nozzle design which produces a uniform cleaning pattern of large droplets. Oil-fired, caster-mounted models or gas-fired, stationary models are available. Tricycle or trailer mounts are optional at extra cost.

Malsbary Manufacturing Co., 845 —92nd Ave., Oakland 3, Calif.

Circle **No. 5-4** on the convenient reply card facing page 34.

Moisture Probe



A system for determining percent moisture and density of soil by nuclear methods is composed of a counting unit (scaler) and a moisture and/or a density probe containing a radioactive material and a detector system. Measurements are made by inserting or placing the probe on the material being tested and making a reading on the portable scaler. This system allows at least 5 to 10 tests to be run in the same period of time required to run one conventional test.

Testlab Corporation, 3398 N. Milwaukee Ave., Chicago 41, Ill.

Circle **No. 5-5** on the convenient reply card facing page 34.

Soil Blender

Unimix, a p.t.o. soil blending-pulverizing machine is designed to work off industrial and agricultural tractors in the 55-80 h.p. class. The Unimix 80 has a mixing width of 80" and can be set to provide mixing depths of from two to eight inches. It uniformly mixes base, sub-base and sub-grade soils in the construction of highways, streets, shoulders, parking areas, runways, earth embankments and dams. The unit is used also in pulverizing and reclaiming old asphalt; introducing moisture for compaction or aerating

soils and can be used with any additive including cement, lime, salt or asphalt emulsions.

Howard Rotavator Co., Harvard, Illinois.

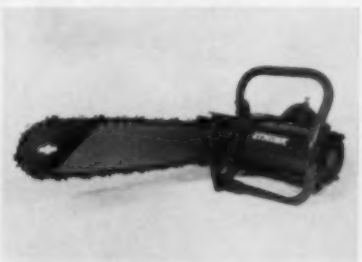
Circle **No. 5-6** on the convenient reply card facing page 34.

Electric Saw

An electric chain saw built to compare with the most powerful models of gasoline chain saws, has the highest horsepower motor utilized in a portable electric tool, 7 hp. There is a centrifugal clutch on the motor which allows for smooth and easy disengagement of the cutting chain at low speeds.

Strunk Power for Modern Living, Inc., Coatesville, Pa.

Circle **No. 5-7** on the convenient reply card facing page 34.



Drop Hammer

A mobile drop hammer, the Henry Model DH-8, is designed for mounting on many makes and models of utility tractors in combination with Henry loaders. The striker weighs 1,000 lbs. and will produce up to 8,000 ft.-lbs. of impact. The striker and mast may be shifted hydraulically to give a total lateral movement of 5 feet. The model DH-8 operates by hydraulic power and features an electronic control for automatic cycling. Control of the unit may be either automatic or manual. The DH-8 may be used for breaking concrete, cutting asphalt or tamping back fill. Special tools are available for all these purposes.

Henry Manufacturing Co., Box 521, Topeka, Kansas.

Circle **No. 5-8** on the convenient reply card facing page 34.

Hydraulic Crane

This lightweight (950 pounds), compact hydraulic unit mounts on a truck bed, taking up only 13 inches of bed space. The Tico handles logs and pipes, pulls cable, sets poles, installs small machinery, hoists building blocks and performs countless other jobs. Tico can also be mounted on medium-size tractors, flatcars, docks, barges, and warehouse platforms. It has a telescoping boom incorporating a built-in winch with a steel wire rope 131 feet long. The boom swings in 360-degree sweep to the left or right. It can be raised to position 23 feet above the ground.

Viking Sales, Kendall, Florida.

Circle **No. 5-9** on the convenient reply card facing page 34.

Vacuum Street Cleaner

The Vac-All Model E-5 vacuum street and highway cleaner is designed for picking up and hauling heavy street and highway debris, sweepings, leaves and similar materials. As a catch basin cleaner, the unit removes catch basin muck, gravel, rock, sand and silt in a matter of a few minutes. The unit has a 16-cu. yard self contained, fully enclosed body, designed for hauling heavy materials. The debris enters the body directly without passing through the blower. The intake hose is supported by a top revolving boom and the entire assembly can be moved in a few seconds to load from either side of the body or for loading from the rear. For dumping the load, a heavy duty hydraulic hoist is used.

Central Engineering Co., Inc., 4429 West State St., Milwaukee 8, Wisconsin.

Circle **No. 5-10** on the convenient reply card facing page 34.

Road Builder

The Model GARB-44 Gurries automatic road builder is a high production road building machine used for grading and spreading operations in highway construction. A unique feature of the unit is its ability automatically to maintain blade height and cross slope in relation to a selected reference. Through an automatic hydraulic system, the height of the blade can be controlled in any one of four manners: 1) blade held in relation to the elevation of a reference wire; 2) blade held in relation to a gauge wheel; 3) right side wheel follow; and 4) blade help in relationship to the plane of the 40′ wheelbase.

Gurries Manufacturing Co., San Jose, Calif.

Circle **No. 5-11** on the convenient reply card facing page 34.

Elm Disease Spray

A liquid homogenized mist spray for complete control of Dutch elm disease, Mist Blo 26C-OF, destroys the scolytus bark beetle which infects the elm while the insecticidal and fungicidal particles kill mites, aphids, chewing and sucking pests and control fungus diseases. A concentrated plant food of nitrogen and salts in the spray liquid assures healthier trees.

Chemical Insecticide Corporation, 30 Whitman Ave., Metuchen, New Jersey.

Circle **No. 5-12** on the convenient reply card facing page 34.

Penetrometer

A pocket style concrete mortar penetrometer for field and laboratory evaluation of the initial set of concrete is designed for use by engineers, contractors, consultants, testing laboratories, cement and concrete plants, highway departments and governmental agencies. The penetrometer which is only 7 inches long can be used in conjunction with ASTM test C-403. The test procedure involves forcing the 1/20 square inch steel penetrometer shaft into concrete mortar to a depth of one inch, as scribed on the shaft. The resistance in pounds per square inch is shown on the penetrometer's direct reading scale by the indicator sleeve which automatically holds its position until released. The scale range is from zero to 700 pounds per square inch.

Soiltest, Inc., 4711 W. North Ave., Chicago 39, Illinois.

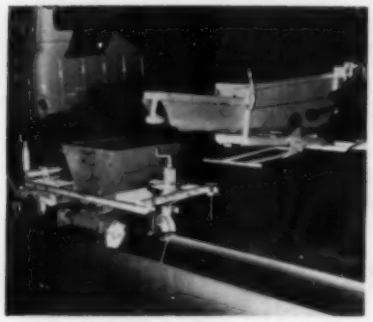
Circle **No. 5-13** on the convenient reply card facing page 34.

Tailgate Loader

This mount-on-tailgate loader for curbing machines features a helicoid spiral spiral screw, 6 in. in diameter and 10 ft. long. This runs the full length of the machine and feeds material from the hopper to the point of application. The curb loader is mounted on the dump truck tailgate with three hook-on chain-type cables. Its capacity is 15 tons per hour. There are shutoff controls at right and left ends of the truck tailgate and forward on the truck body.

Miller Spreader Corp., 4020 Simon Road, Youngstown, O.

Circle **No. 5-14** on the convenient reply card facing page 34.



Hydraulic Hoe

Yumbo, an all-hydraulic hoe-loader-shovel, is manufactured in crawler and self-propelled models with a wide range of working attachments. The basic unit is also factory-mounted on crane-type carriers or is available for mounting on conventional trucks. Model 35 offers a rough-terrain crawler with low ground pressure, and features a high-torque piston type hydraulic motor driving each track independently. The crawler also features sealed lifetime tapered bearings in track rollers.

Hydraulic Equipment and Shovel Company, Bank of The Southwest Building, Houston 2, Texas.

Circle **No. 5-16** on the convenient reply card facing page 34.

Bump Cap

A lightweight, resilient, and chemically resistant, protective headpiece, the "Bump Cap" is designed for use in areas where there is no hazard of falling objects. It weighs less than seven ounces, has a two-inch square space for insignia, and is available in white or yellow. Special colors may be obtained on request. The plastic cap is equipped with removable, adjustable suspension and a chin strap.

Mine Safety Appliances Company, 201 North Braddock Ave., Pittsburgh 8, Pennsylvania.

Circle **No. 5-15** on the convenient reply card facing page 34.

Line Guard

The MB Line-O-Guards provide positive protection for newly painted traffic lines. The spiked shape causes motorists to avoid them yet the guards are harmless to cars because of flexible construction. Made of polyethylene plastic, they are weather proof and resistant to grease and chemicals. The guards are of permanently colored material throughout and have weighted bases and large holes in the sides for easy retrieving. They can be stacked for compact storage.

M-B Corp., New Holstein, Wis.

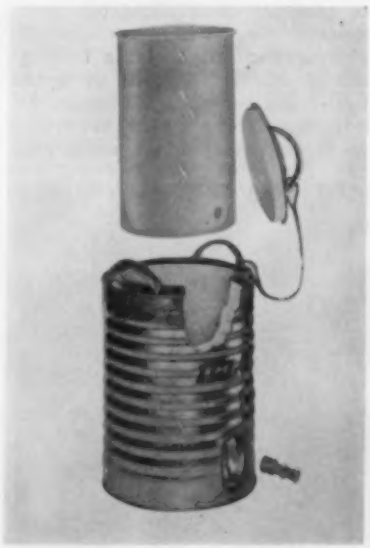
Circle **No. 5-17** on the convenient reply card facing page 34.

Water Cooler

Four plastic-lined models of portable water coolers are available in 2, 3, 5 and 10-gallon sizes for either hot or cold liquids. Galvanized steel, corrugated outer wall, is used with urethane foam applied inside as insulation. A seamless plastic liner to hold the liquid is then inserted into the cooler. This high-density polyethylene liner offers good sanitation, freedom from taste and odors, high temperature resistance and is replaceable.

Igloo Corporation, P. O. Box 7185, Memphis 18, Tennessee.

Circle **No. 5-18** on the convenient reply card facing page 34.



Catch Basin Cleaner

The larger model Elgin Eductor, Model 2-M, features a 2,000-gallon tank with a large increase in material capacity for catch basin and underground cleaning work. In addition, it will increase the capacity for street flushing, fire-fighting, sewer flushing and tree insect spraying.

The Elgin Corporation, 222 West Adams Street, Chicago 6, Ill.

Circle **No. 5-19** on the convenient reply card facing page 34.

Soil Stabilizer

A self-propelled, inplace soil stabilization machine, the Bros Model SPRM-84 Roto-Mixer, is a heavy-duty machine for mixing, blending, aerating and pulverizing windrowed and subsurface materials to a maximum depth of 10 inches. Mixing and blending of windrowed gravel materials is accomplished at rates of 3,000 to 5,000 cu. yds. per hour. Subsurface mixing of scarified materials is done at rates up to 1,000 cu. yds. per hour. The rotor and hood assembly is raised or lowered by hydraulic action of the trailing wheels. Positive control of work depth is accomplished because of the center slung mixing unit between supporting wheel axles. The optional spray system provides control in adding water, oil, asphalt or asphalt emulsions into the material being processed. The additives are sprayed into the mix at the upper front of the mixing chamber to assure thorough blending. Pivotal rear wheels can track the front wheels where working conditions permit but are swung out to a width of 10 ft. for windrow work or aeration.

Bros Incorporated, Road Machinery Div., 1057 Tenth Ave., S.E., Minneapolis 14, Minnesota.

Circle **No. 5-20** on the convenient reply card facing page 34.

Safety Cones

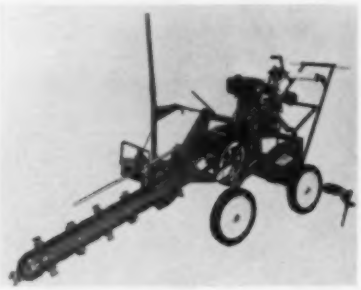
These traffic cone markers in bright fluorescent red for high visibility, are made of one-piece rotationally-cast plastisol for long life. The cones are resistant to tearing, cutting, gasoline, oil, tar and paint. The fluorescent red has the ability to reflect light or if lighted from within, the brilliant red cone can be seen from great distances, making them ideal lighted markers for safety islands, drive approach areas, airport taxi and loading areas.

Jobet Industries, Inc., 547 W. South Park Ave., Oshkosh, Wis.

Circle **No. 5-21** on the convenient reply card facing page 34.

Portable Trencher

A light-weight portable trencher, the Digz-All weighs 345 pounds and will dig a trench three inches wide with any depth to 32 inches at up to ten or more feet per minute depending upon the soil conditions. The unit is designed to provide fast, economical trenching for water pipes, sprinkler systems and utility lines. The boom may be raised to vertical position for storage or transportation. Overall length is 57 inches with the boom raised; height is 35 inches; it is 29 inches wide. It has a 4 hp Kohler or Clinton engine with oil bath air cleaner and a mechanical flyball governor with hand speed control.



Wind-King Mfg. Co., Merrill, Iowa.

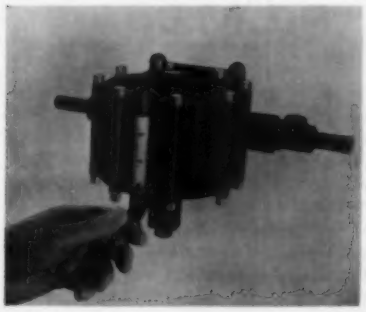
Circle **No. 5-22** on the convenient reply card facing page 34.

Asphalt Lute

The Model KL-30 lute has a self-contained heating element which keeps the blade hot to such a degree that it will not retain any excess asphaltic material. The lute is kerosene fired and will operate approximately four hours on one filling. Constructed of aluminum and steel, the unit is light in weight and leakproof. All parts are replaceable.

Continental Asphalt Equipment Co., P. O. Box 44, Toledo 14, Ohio.

Circle **No. 5-23** on the convenient reply card facing page 34.



Chlorinizer

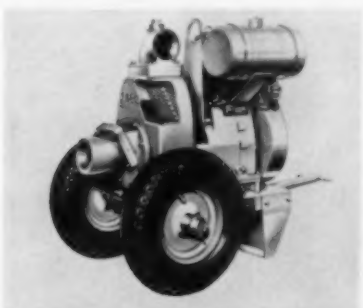
This low cost chlorinizer, compact and simple in design, which mixes chlorine gas with water and feeds the resultant solution, is suited for sterilization of drinking water, swimming pool water and sewage or waste treatment plant effluent. The Model 845 Chlorinizer mounts on a wall, needs no floor space and will feed in ranges of 2-28, 5-50 and 10-100 lbs. per 24 hours. Range can be altered, with the unit in operation, by simply changing the meter tube. A minimum amount of water is required to operate the Model 845 and only five psig chlorine gas pressure is needed to assure maximum feed. Safe in operation, the unit immediately stops if the water supply is interrupted.

B-I-F Industries, P. O. Box 276, Providence, R. I.

Circle **No. 5-24** on the convenient reply card facing page 34.

Trash Pumps

Designed to handle any dewatering job, these trash pumps feature an exclusive PosiJector that assures positive ejection of debris when pumping dirty water. This channels trash directly into the pump discharge flow and prevents recirculation of solids larger than ¼" which normally cause clogging and rapid wear. The pumps have a heavy 2-bladed impeller that passes large diameter solids, and a big-opening strainer that handles sticks and leaves without clogging. In addition, the entire suction chamber can be removed quickly and easily for periodic cleaning and inspection or adjustment of liner plate and impeller. Available in 3" and 4" sizes with capacities of 20,000 and 46,000 gph at 10' suction lift.



Jaeger Machine Company, Columbus 16, Ohio.

Circle **No. 5-25** on the convenient reply card facing page 34.

Slurry Gun

Spray-Tex, a lightweight portable slurry and texture gun, is designed for spraying texture paint, acoustical plaster, waterproofing or sand finish coats and is especially useful in painting or repairing masonry structures. The unit can cover over 4,000 sq. ft. a day. Small and compact, it weighs only 125 pounds and has adjustable feed control on the hopper, quick change orifices for texture control and a built-in compressor driven by a 1 hp, 60 cycle, 110 volt, electric motor.

Air Placement Equipment Co., 1000 West 25th Street, Kansas City 8, Missouri.

Circle **No. 5-26** on the convenient reply card facing page 34.

Mobile Compressor

An all-purpose 2-cylinder mobile air compressor, specifically designed for spray painting, all-purpose spraying, air cleaning and pneumatic tool operation, the QR Series compressor is built to meet the needs of painting contractors, plant maintenance, shops and garages. Available with either a 1 hp electric motor or a 3 hp gas engine, the twin cylinder compressor provides air delivery of 5.4 cfm at 45 psi, 4.0 cfm at 100 psi. It is designed for a working pressure of 100 lbs. continuous operation, 150 lbs. intermittent. A complete selection of

accessories is also available for the unit including spray guns, material containers and blow guns.

The Campbell-Hausfeld Company, Harrison, Ohio.

Circle **No. 5-27** on the convenient reply card facing page 34.

Transit in Color

The Paragon transit is now available in a matte, two-tone green after more than 75 years of manufacture in black. The change came after extensive field tests proved that the two-tone green provided maximum reflection of heat. Other features of the transit include: a fully achromatic, completely enclosed optical system; a two-speed tangent screw; spanned verniers; a chrome-plated forged Everdur inner center; a chrome-plated draw tube; and stainless steel axle journals.

Keuffel & Esser Co., Third and Adams Streets, Hoboken, N. J.

Circle **No. 5-28** on the convenient reply card facing page 34.

Tractor Cabs

Maximum operator protection is provided in this heavy duty cab designed especially for hazardous operations with the Caterpillar 630 four-wheel tractor. One of five cab arrangements developed for this model tractor, Model SC630A in-

ATTENTION
LANDSCAPE ARCHITECTS
NEW CHEMICAL CONCENTRATE
ENDS REST AREA PRIVY ODORS!

Get Complete Proven Success with

SANI-SEPTIC

CONCENTRATE

FORMULA—500—I. R. B.

Revolutionary new Sani-Septic Concentrate is a complete new approach to the problem of rest area odor control. The result of extensive research and development, Sani-Septic Concentrate destroys the bacteria that are the source of privy odors. Unlike other products, Sani-Septic is not a perfume or odor "cover-up." It leaves no odor of its own. San-Septic is a liquid that is diluted with water and poured into the privy vault. It destroys present odors and future odors. It is economical to use and is unconditionally guaranteed to provide the sanitation required. Test installations in the State of Ohio rest areas and roadside parks have proven the unique effectiveness of Sani-Septic Sanitation.

Why Sani-Septic Destroys Odor

Sani-Septic Concentrate completely ends odor where others fail because it controls the growth of the micro-organisms that produce sulphides with their strong unpleasant odors. In addition it prevents the growth of fungi that speeds decomposition of waste materials and resulting offensive odors.

Send for complete information.

WERLEY CHEMICAL & SUPPLY CO.

1505 Broadway
Cleveland 15, Ohio

cludes a 3/16-in. steel canopy with structural steel members which are welded to the cab and braced to the tractor frame. Heavy steel guards at the top and rear and a steel grill over the back window further shield the operator. In addition to safety, the cabs offer large interiors, ready access to controls, roll-down windows, window vents, insulated ceilings and large windshields.

Crenlo, Inc., 1600 Fourth Ave. N.W., Rochester, Minnesota.

Circle **No. 5-29** on the convenient reply card facing page 34.

Job Opportunity and Positions Wanted

Qualified Young Engineer Available

A graduate engineer 31 years old with experience in city public works engineering is available. In addition to 4½ years in municipal engineering, his experience has included three years with Navy public works as CEC officer and two years in construction. East Coast area is preferred or desired. Write Box 5-3, Public Works, 200 South Broad St., Ridgewood, N. J.

Unusual Opportunity for a Sanitary Engineer

A manufacturer of waste treatment equipment desires to expand its own sales force and seeks an experienced sanitary engineer who is capable of directing a sales staff of ten or more. He should also be able to direct sales promotion of sewage treatment equipment for municipal plants. Salary is in five figures, with liberal profit sharing and incentive plans. Location is in the Chicago area; travel up to one-third of the time is likely. Sales will be primary responsibility, but work will include research and development, advertising and aid in product design. Opportunities are very great; high educational and other qualifications are necessary. Write Box 5-4, Public Works, 200 So. Broad St., Ridgewood, N. J.

Sales Representative

An experienced and well-known man desires to handle water and sewage equipment in the Southern California area. Write Box 5-X, Public Works, 200 South Broad St., Ridgewood, N. J.

FILMS in Brief

Listed below are motion picture films of current interest to engineers, administrators and supervisors in the public works field. The companies providing these films have indicated that the films are available for appropriate use by PUBLIC WORKS readers. Requests for films should be made direct to the company listed with the film.

"The Marshall Method for Design of Hot-Mix Asphalt Pavements." Technical training film. (25 min., color, sound, 16 mm.) The Asphalt Institute, Asphalt Institute Bldg., Univ. of Md., College Park, Md.

"Water for Farm and City." The story of water for farm, city, industry, recreation and wildlife. Explains why water problems affect everyone. (13½ min., black and white, 16 mm.) Motion Picture Service, Office of Information, U. S. Dept. of Agriculture, Wash. 25, D. C.

"Building A Highway." Follows progress of man in road building including ingenious planning and construction techniques of modern highways. (18 min., color, sound, 16 mm.) Portland Cement Association, care of Modern Talking Picture Service, 129 Third Ave., S. W., Cedar Rapids, Iowa.

"How to Build New Shapes in Concrete." Describes many popular shell forming developments, lightweight scaffolding, precast and earth forms. (19 min., color, sound, 16 mm.) Local district office of Portland Cement Association.

"Lime Stabilization of Roads." Lime's use in stabilizing marginal clayey soils on projects for highways and streets, showing typical construction procedures for subgrade and base courses. (23 min., color, sound, 16 mm.) National Lime Association, 925-15th Street, N.W., Washington 5, D. C.

NEWS OF ENGINEERS

THOMAS R. GLENN, Jr., Director and Chief Engineer of the Interstate Sanitation Commission, New York City, is now also executive Secretary of the American Sanitary Engineering Intersociety Board. The office of the ASEIB will be transferred to 117 Benner St., Box 143, Highland Park, N. J.

ROBERT A. ADAMS and THOMAS P. MELONE have been appointed Division Directors in the Department of City Planning of the City of Chicago.

L. S. MORGAN has resigned as chief of the Pennsylvania Health Department's mine drainage section to become director of environmental health for the Bucks County, Pa., Health Department.

HAROLD K. PRATT has been appointed Chief Civil and Hydraulic Engineer of Stanley Engineering Company, Muscatine, Iowa. In his 25 years of experience in civil engineering work with emphasis on hydraulics, Mr. Pratt has been connected with numerous projects involving dams, locks, levees, canals, hydrologic studies and other problems encountered in large hydroelectric developments.

CHARLES F. BIRD and ALBERT M. TIETZEL, civil engineers, Columbus, Ohio, have dissolved their partnership. Mr. Bird has formed the firm of Charles F. Bird and Associates with offices in Worthington, Ohio, for the practice of consulting civil and municipal engineering and surveying. Chief associate is RICHARD J. BULL.

HAROLD P. KING, partner in the consulting firm of King, Benioff and Associates, Sherman Oak, Calif., will be installed as president of the Consulting Engineers Council at the annual board of directors meeting in Chicago, May 4-6. Mr. King is past president of the Consulting Engineers Association of California.

Five engineers have been made members of the consulting engineering firm of Burns & McDonnell, Kansas City, Mo. The new members are: LEO L. CUNNINGHAM, JASPER W. MEALS, ALWIN H. RECTOR, WILLIAM W. RUMANS and EDWIN J. RUNYAN. Messrs. Cunningham, Meals and Runyan are civil engineers and Messrs. Rector and Rumans are electrical engineers.

AUGUST W. COMPTON has been elected president of Leigh Fisher Associates, Inc., airport consultants of San Francisco, Calif.

CLASSIFIED ADVERTISING AND JOB OPPORTUNITIES

TECHNICAL SALES AND SERVICE WATER TREATMENT

Unusual opportunity for graduate chemist or chemical engineer with at least 5 years experience in water field. Must be free to travel and thoroughly familiar with municipal and/or industrial water treating systems. Salary open. Send resume of background now for interview at Detroit AWWA Convention, or after June 15th. to:

Mr. S. Bruce Humphrey
Director of Marketing
Carus Chemical Co., Inc.
1380 Eight Street
LaSalle, Illinois

ADMINISTRATIVE ENGINEER AVAILABLE

Graduate Civil Engineer, age 31, is seeking a permanent, challenging position. Desires East Coast location. Minimum salary of at least $750 per month. Experience includes Navy C.E.C. Officer, City Engineer, and Assistant to Director of Public Works. Member of A.P.W.A. and A.S.C.E. Complete resume will be sent upon request.

Write to:
Box 5-3
Public Works Magazine
200 South Broad Street
Ridgewood, New Jersey

CIVIL ENGINEER

The City of Hamilton, Ohio, population 73,000, is recruiting for experienced graduates and/or Professional Civil Engineers. Work includes the development of civil engineering projects such as highways, sewers, subdivision plats and various need studies in Public Works. Positions offer good pay, pleasant working conditions and a complete employee benefit program.

Send resume to:

Director of Civil Service
Room 254
Municipal Building
Hamilton, Ohio

Sales Engineer Available

Experienced sales engineer, 40, married, ME degree is available. Has sold engineered and packaged products to industries, consulting engineers, contractors, municipalities and original equipment manufacturers. Wishes to join progressive organization in a responsible engineering sales capacity. Now in East but will relocate.

Write to: **Box 5-2**
Public Works Magazine
200 South Broad Street
Ridgewood, New Jersey

SENIOR ENGINEER

For Public Works Department. Experience required in all branches of Municipal Engineering for City of 40,000. Salary $6,500 to $8,100 based on experience. Send detailed resume to:

City Manager
Poughkeepsie, N.Y.

SEWAGE PLANT EQUIPMENT FOR SALE

All removable components of the following described sewage plant are hereby offered for sale:
Trickling filter type sewage plant constructed in 1948. Originally designed for 5,000 population, later increased to 10,000. Four Chicago Pumps, theoretical capacity 4.9 M.G.D., 100,000 B.T.U. sludge heater (P.F.T.).

For information contact:

Robert E. Hollander
Acting Village Manager
Village of Palatine
54 S. Brockway Street
Palatine, Illinois

Assistant Borough Engineer and General Inspector

The Borough of Grove City, Pennsylvania is receiving applications for the position of Assistant Borough Engineer and General Inspector. Work involves municipal engineering, building inspection, capital budget programing and functional supervision of public works projects including street, water and sewer work. Possibility of eventual appointment as Borough Engineer. Training and experience required: two years of public works engineering experience and a civil engineering degree.

For further information contact:

Borough Manager
Grove City Borough
200 East Main Street
Grove City, Pennsylvania

Sanitary Sales Engineer

Graduate Engineer wanted. Must be able to direct effectively ten or more salesmen and also to supervise sales promotion of sewage treatment equipment for municipal plants. Salary in excess of five figures, plus profit sharing and sales incentive plans. Location Chicago area. Travel up to one third of time. High education and experience qualifications are desired.

Write to:
Box 5-4
Public Works Magazine
200 South Broad Street
Ridgewood, New Jersey

STEEL PIPE

For Every Purpose
ALL SIZES: 4" to 72" O. D.

Large Stocks—Immediate Delivery
Cutting and Coating Service Available
Our Trucks Deliver Anywhere in USA

For our money-saving low prices on one piece or a carload . . . write, wire or call (COLLECT) . . .

PRospect 3-3020

Valley Steel Products Co.
124 Sidney St., St. Louis 4, Mo.

OZONE GENERATORS

Manufacturers representatives & distributors wanted. Unique lease plan assures you high earnings with annuity, saving municipality to $370.00 monthly on lift station odor control. Specified by leading engineers. Exclusive territories.

INVEX, INC.
Box 1335
No. Miami 61, Florida

INDEX OF ADVERTISEMENTS

Acker Drill Co., Inc. 44
Acme Wire Company 86
Air Placement Equipment Co. 43
Alabama Pipe Co. 76
Allis-Chalmers 62
Aluminum Company of America ..... 30 & 31
Amchem Products, Inc. 148
Amercoat Corporation 170
American Bitumuls & Asphalt Co. 149
American-Marietta Company 13
Concrete Products Division
American Playground Device Co. 187
Anthracite Equipment Corp. 48
Armco Drainage & Metal Products 57
Asplundh Chipper Co. 90
Aurora Pump Division 178
The New York Air Brake Co.
Ayer-McCarel Clay Co., Inc. ..... 10 & 11

B-I-F Industries 173
Badger Meter Mfg. Company ..... 23, 54 & 55
Baughman Manufacturing Company 151
Bowerston Shale Co. ..... 10 & 11
Butler Manufacturing Company ..... 67 & 68

Cannelton Sewer Pipe Co. ..... 10 & 11
Case Company, J. I. ..... 32 & 33
Cast Iron Pipe Research Assoc. ..... 8 & 9
Caterpillar Tractor Company 72
Engine Division
Caterpillar Tractor Company .... 4, 28, 29 & 83
Central Engineering Co., Inc. 186
Chase Manhattan Bank 61
Chevrolet ..... 64 & 65
Div. of General Motors
Chicago Pump Company 3
City Tank Company 183
Clark Equipment Company 147
Construction Machinery Division
Classified Ads 200
Cleveland Trencher Company 145
Clow & Sons, Inc., James B. ..... 24 & 25
Columbia Southern Chemicals 77
(refer to Pittsburgh Plate Glass Co.
Chemical Division)
Combustion Engineering ..... 26 & 27
Computer Measurements Company 160
Utilities Instrument Division
Cushman Motors 45
A Subsidiary of Outboard Marine Corp.

Darley & Co., W. S. 162
Deere, John 17
Dempster Brothers 58
Diamond Alkali Company 155
Dickey Clay Mfg. Co., W. S. ..... 10 & 11
Dow Chemical Company 46

Eddy Valve Company 157
Eimco Corporation 181
Ellis Distributing Co. 187
Ellis & Ford Mfg. Co. 184
Enterprise Engine & Machinery Co. 75
Equipment Engineers, Inc. 171
Essick Mfg. Company 92
Euclid 53
Div. of General Motors Corp.
Evans Pipe Company 175

Fisher Research Lab., Inc. 184
Fitchburg Engineering Corp. 143
Flexible, Inc. 36
Flex-O-Lite Manufacturing Corp. 89
Ford Motor Company ..... 14 & 15
Ford Motor Company 60
Tractor & Implement Division
Forneys Inc. 187
Foster Company, L. B. 18
Foxboro Company ..... 98 & 99

Galion Iron Works & Mfg. Co. ..... 20 & 21
Gar Wood Industries, Inc. 140
Georgia-Pacific 16
Good Roads Machinery Corp. 48
Gorman-Rupp Company 179

Hamilton Kent Mfg. Co. 69
Hersey-Sparling Meter Co. ..... 97 & 161
Hotel Tuller 184
Hough Company, Frank G. 37
Howard Rotavator Co., Inc. 12

International Harvester
Co. ..... Second Cover, 84 & 85
Irving Subway Grating Co., Inc. 22

Jeffrey Mfg. Co. 159
Johns-Manville ..... 82 & 94

Kohler Company 52
Komline-Sanderson Engr., Corp. 49
Koppers Company, Inc. 185
Tar Products Division

Leece-Neville Company ..... 50 & 51
LeTourneau-Westinghouse Co. 87
Link-Belt Company 93
Lock Joint Pipe Co. 73

M-B Corporation 150
M & H Valve & Fittings Co. 168
McConnaughay Mixers, Inc. 40
McGowan Pumps 165
Division of Leyman Mfg. Corp.
Measure-Rite Division 23
Badger Meter Mfg. Co.
Morse Boulger Inc. 180
Mueller Co. ..... 19 & 164

Natco Corp. ..... 10 & 11
National Clay Pipe Mfgrs., Inc. 100

Oliver Corporation ..... Third Cover

Pacific Flush Tank Co. 167
Palmer Filter Equipment Co. ..... 42 & 48
Permutit Division 163
Pfaudler Permutit Inc.
Pittsburgh Plate Glass Co. 77
Chemical Division
Pomona Terra-Cotta Co. ..... 10 & 11
Prismo Safety Corp. 153
Price Brothers Company 91
Public Works ..... 66 & 186

Republic Steel Corporation ..... 70 & 71
Roberts Filter Mfg. Co. 142
Rockwell Manufacturing Company 169
Roof Manufacturing Company 154

Sanfax Corporation 59
Schield Bantam Co. 47
Seaman-Gunnison 95
Division of Seaman Corp.
Smith & Loveless 177
Smith Mfg. Company, A. P. 163
Smith & Company Inc., Gordon 144
Steel Plate Fabricators Assoc. 158
Steiert & Sons, Inc. 142
Synchro-Start Products Inc. 42

Tarrant Manufacturing Co. 44
Taylor & Co., W. A. 172
Tennessee Corporation 88
Texas Vitrified Pipe Co. ..... 10 & 11
Tex-Vit Manufacturing Co. 63
Thiokol Chemical Corp. 96
Thompson Pipe & Steel Co. 165
Trickling Filter Floor Institute ..... 10 & 11
Troy Blanket Mills 35

Union Metal Manufacturing Co. 6
Unit Crane & Shovel Corp. 41
United States Concrete Pipe Co. 39

Valley Manufacturing Co. 56
Vermeer Manufacturing Company 38
Visi-Meter, Inc. 162

Wallace & Tiernan Co., Inc. ..... Back Cover
Wausau Iron Works 154
Worley Chemical & Supply Co. 200
Western Waterproofing Co. 162
Westinghouse Electric Corp. ..... 78 to 81
Weston Co., L. A. 180
Wico Machine Works, Inc. 56
Wilkinson Products Company 150

CONSULTING ENGINEERS APPEAR ON PAGES 188 to 193

PUBLIC WORKS JOURNAL CORPORATION

200 South Broad Street Ridgewood, New Jersey

OFFICERS

W. A. Hardenbergh, *President* — Lewis C. Morris, *Vice President and Treasurer* — Edward B. Rodie, *Secretary*

BUSINESS DEPARTMENT

Lewis C. Morris, *General Manager* — Arthur K. Akers, *Director, Advertising & Research* — I. James Barger, *Business Manager*

ADVERTISING OFFICES

CHICAGO 1, ILLINOIS
333 N. Michigan Avenue
Robert J. Shea
Mid-West Sales Mgr.

CLEVELAND 41, OHIO
10531 Snowville Road
Burton M. Yost,
District Manager

KANSAS CITY, MO.
4916 West 64th St.
Mission, Kansas
C. H. Stockwell

LOS ANGELES 36, CALIF.
5478 Wilshire Blvd.
% Smith and Hollyday
Hugh Hollyday
David W. Zander

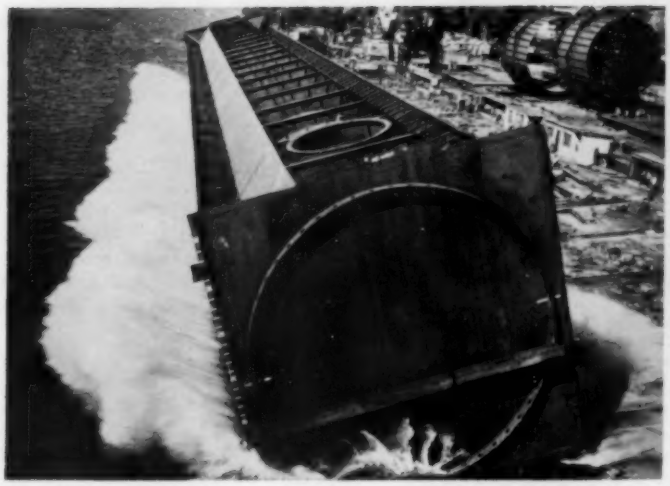
PHILADELPHIA 10, PENN.
1434-36 Land Title Bldg.
Rod Ellis

RIDGEWOOD, NEW JERSEY
200 South Broad Street
W. S. Morris

SAN FRANCISCO 4, CALIF.
22 Battery Street
% Smith and Hollyday
Bill Smith

LONDON, W.1., ENGLAND
Regency House
1 Warwick Street
Norman F. Keenan

WORTH SEEING



A 300-foot welded steel tunnel section, one of 12 which will form a vehicular tunnel connecting Norfolk and Portsmouth, Va., splashed into the water at the fabricating yard. Carloads of electrodes were used to weld the 33-foot ID tube, shown in this Lincoln Electric Company photo.

A new protective barrier to prevent head-on collisions is planned for all sections of the Pennsylvania Turnpike except where grass medians are 90 feet or wider. Armco Flex-Beams are being used for initial 60-mile section.

Huber-Warco motor grader owned by Yoakum County, Texas, being used to rebuild a farm road washed out by recent heavy rains. Sandy material must be worked when wet during prevailing heavy winds.

Traveling demonstration of latest pavement striping equipment takes to the road as the Linestriping Caravan of M-B Corp., New Holstein, Wis., gets under way. **Models range** from hand propelled to heavy duty truck mounted sizes.

by Arthur K. Akers

★ Fairbanks, Morse & Co. appoints **John P. Henebry** to the newly-created position of director, Water Division, making and marketing equipment for desalting seawater. **John W. Chandler** becomes assistant manager diesel sales of F-M.

★ **J. T. Pitts** named sales manager, Brown Instruments Division, Minneapolis-Honeywell Regulator Co. He was most recently Southwestern regional manager, at Dallas.

Mr. Burns

★ **Ross J. Burns**, formerly general sales manager of the water meter division, Badger Meter Mfg. Co., Milwaukee, has been elected vice president in charge of municipal sales. Mr. Burns has been associated with the water meter industry for thirty years.

★ Multiplex Mfg. Co., Berwick, Pa., manufacturers of Crispin air valves, celebrates its Golden Anniversary.

★ Universal Motor Co., Oshkosh, Wis., acquired by J. M. Nash Organization. Product in this field is electric power and light plants.

★ **Frank P. MacDonald** becomes president of Electro Rust-Proofing Corp., cathodic protection. E.R.P. is a Wallace & Tiernan subsidiary.

★ Valley Mfg. Co., Valley, Neb., appoints four new regional representatives as part of its expansion program in its steel lighting pole division.

★ Lock Joint Pipe Co. has acquired Corroplast Inc., Passaic, N. J., makers of rigid PVC plastic pipe.

★ **Carl E. Boat** succeeds **Bill Willinger** as sales manager, Vermeer Mfg. Co., Pella, Iowa, makers of ditching and stump removal equipment. Willinger establishes his own firm, representing Vermeer in Minnesota and Wisconsin.

★ **Joseph Albiez** appointed sales manager, Flygt Corporation, pumps. He will have charge of sales of all Flygt products.

★ **J. C. Macon, Jr.**, moves up from sales manager to vice president in the Tar Products Division of Koppers Co., Pittsburgh.

★ As the pictured tent shows, "progress wore a canvas coat" at Springfield, Ill., recently, as Allis-Chalmers unveiled nine new models of construction machinery at a "Power Parade." About 1,000 dealer, company and press representatives were at the opening. Vice Presidents **W. C. Scholl** and **Boyd S. Oberlink** spoke of the definite signs of pick-up that accompany increases in construction activity including highways, soil conservation projects, public works and military installations. Major new A-C models on display included some very large motor scrapers and tractor loaders together with a medium-sized 105 hp motor grader and a new "small" motor scraper with 13-ton carrying capacity.

★ **J. F. Bailey**, executive vice president of Texas Vitrified Pipe Co. and of Southwestern Plastic Pipe Co., Mineral Wells, Texas, announces these firms will award a university scholarship in engineering to a high school graduate this year, in the amount of $600.

★ Southern Cement Co., Birmingham, a division of American-Marietta Co., will begin construction of a multi-million dollar cement plant near Atlanta, Ga.

★ National Corrugated Metal Pipe Association elects these officers: President, **G. H. Garrett** of Thompson Pipe & Steel Co.; Vice Presidents, **A. J. Mistler** of Armco Drainage & Metal Products, Topeka, and **B. G. Stone** of Spokane Culvert & Fabricating Co.

★ Wausau Iron Works, Wausau, Wis., purchases Thrun Mfg. Co., Pine City, Minn. Products manufactured will be soil compaction and stabilization equipment for highways and airports.

★ **Thomas Hollingsworth** named vice president, sales, of Hubbard & Co., pole line hardware and electrical equipment. The company moves in May to 5401 W. Roosevelt Road, Chicago.

★ Wife: "Our new washwoman is a thief!" Husband, "A thief?" Wife, "Yes, she took two of our towels." He, "Which ones?" She, "Those we brought from the hotel in Miami!"

Allis-Chalmers "Power Parade" displayed 50 models of construction equipment.

Small size to get you in anywhere for more profits out of any job—the Oliver OC-46, with fast-action backhoe.

MORE DIG PER DOLLAR

Spend your equipment dollars where they'll dig you the most and earn you the best.

Each of these Oliver tractors is out front in its class for backhoe performance—bigger money-makers for distinctively good reasons:

OC-46 WITH BACKHOE—The lowest priced digging-dozing-loading machine in its compact class. A proved performer—backed by over 60,000 Olivers its size produced before today's highly developed model. Quick-hitch backhoe—hook on or off in a minute. Digs down to 11′10″, reaches out to 12′11″, loads up to 9′6″. Easy, second-splitting hydraulic controls—cushioned for smoother, precision response. Tool up with an OC-46 loader, the factory-built and matched low-silhouette, high-stability loader, and you have an unequaled high-profit machine ready to earn at more jobs. Now ask about its low price. Set up a demonstration.

You've never had it so easy before in crawler-tractor operation—or so fast—as with the Oliver OC-96, now with backhoe.

WITH THESE RAPID CYCLE OLIVERS

OC-96 WITH BACKHOE—Now you're talking production—really high, wide and handsome trenching or excavating. It's important to remember that the OC-96 is the world's easiest-to-operate crawler. More modern design is why—the leader in its class for advancements. Fully powerized operation with three types of turns through Oliver's exclusive Trans-O-Matic transmission.

Now this rugged speed artist with factory-built loader is offered with matched, close-mounted backhoe. Has quick attach and detach. Full 200° swing of deep 13′ digging bucket for wide, either-side casting to 14′7″. Load out to 8′6″. Long back reach to 18′9″ means fewer machine settings, added productivity. Hydraulic outriggers. Buckets to 11-cu.-ft. capacity. Now, size it up and price it out—get the full story on this modestly priced, more modern crawler tractor.

OLIVER CORPORATION, Chicago 6, Illinois

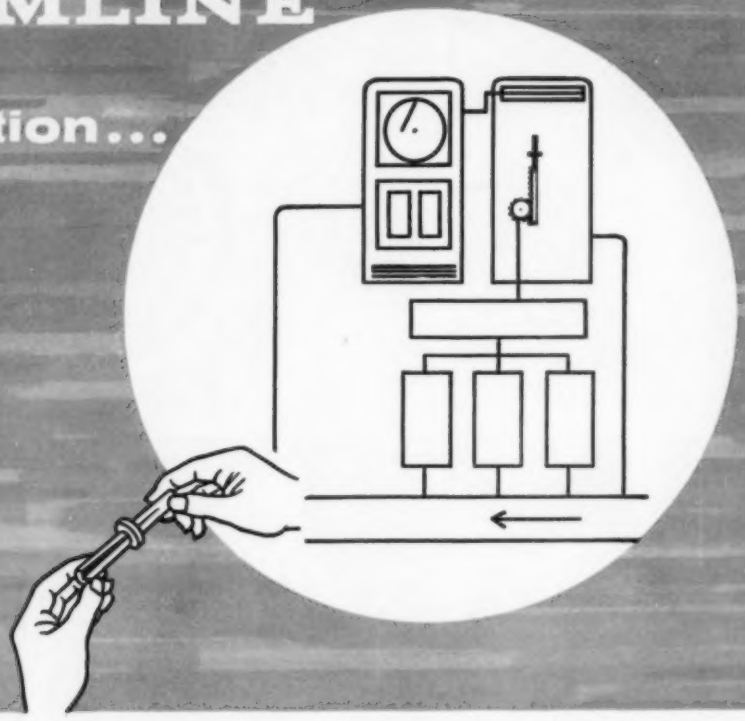
SEE YOUR

OLIVER

DEALER

Turn to your dependable Oliver dealer when you need hurry-up service and genuine Oliver spare parts.

Let automated control STREAMLINE your chlorination...



W&T **COMPOUND-LOOP CONTROL**

With automation by Wallace & Tiernan your chlorination system controls itself...needs almost no attention. With Compound-loop Control, the residual you select is maintained, no matter how much water flow or chlorine demand changes. You're always sure of water quality.

W&T Compound-loop Control means true process control. Because it analyzes the end result and feeds back information which monitors your chlorinator, Compound-loop Control successfully achieves a closed-loop system. This means an operating range of greater than 100 to 1, plus round-the-clock supervision without extra labor.

And you can control free or total residual...use electric, pneumatic, or variable vacuum signals. W&T Compound-loop Control can be tailored to the physical layout of your system, your flow-metering equipment, your plant hydraulics. You build or convert to automation with maximum convenience, minimum expense.

For more information, write Dept. S-141.78

WALLACE & TIERNAN INCORPORATED

25 MAIN STREET, BELLEVILLE 9, NEW JERSEY